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ABSTRACT

This report examines the effects of both student and school characteristics on mathematics and science achievement levels in the third, seventh, and eleventh grades using data from the 1985-86 National Assessment of Educational Progress (NAEP). Analyses feature hierarchical linear models (HLM), a regression-like statistical technique that addresses the problem of students nested within schools by directly modeling within- and between-schools variation in achievement. Additionally, HLM allows examination of the impact of school characteristics on the relationship between student characteristics and achievement within schools. Following an executive summary, this report contains: (1) an introduction including information on the background and purpose of the study, a description of data sources and variables used in the analyses, and an outline of the methodological approach utilized; (2) a summary of the effects of school characteristics on mathematics achievement for each of the three grades with respect to the within-school model and the five between-school models; (3) a summary of the effects of school characteristics on science achievement for each of the three grades with respect to the within-school model and the five between-school models, enlarged with a comparison of mathematics and science results; (4) an extensive discussion of the findings in relation to methodological goals, grade level differences, school size, disassociation of socio-economic influences from race-ethnicity, tracking, gender differences, and teacher characteristics; and (5) appendices that include technical notes for the variables and the HLM methodology, descriptive statistics for selected characteristics, and supporting tables for the HLM results. In general, the school characteristics examined in the analyses provided better explanations for average achievement between schools than they did for the effects of gender, race-ethnicity, and socioeconomic status on achievement. (JJK)

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Research and Development Report June 1992

National Assessment of Educational Progress

School Effects on Educational Achievement in Mathematics and Science: 1985–86

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Foreword

The Research and Development (R&D) series of reports has been initiated:

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Executive Summary

This report examines the effects of school characteristics on mathematics and science achievement in the third, seventh, and eleventh grades using the data from the 1985-86 National Assessment of Educational Progress (NAEP). The effects of both student characteristics and school characteristics on mathematics and science achievement levels were examined. The school-level characteristics represented aspects of the school environment that have been shown in the school effectiveness literature to be related to student achievement. Five groups of characteristics that could be measured in the NAEP dataset were used: student body characteristics, fiscal and physical characteristics of the school, school program structure, school academic standards, and principal and teacher characteristics.

The report used a new, regression-like statistical technique—hierarchical linear models (HLM)—which allowed student achievement to be explained as a function of school-level characteristics. In addition, HLM allowed for the examination of the impact of school characteristics on the relationship between student characteristics and achievement within schools. For example, the size of the effect of gender on achievement—or the size of the gap between males and female achievement—differed between schools. HLM allowed for the examination of the effects of school characteristics on the size of the gap between male and female achievement.

For each subject and grade, HLM models examined the effects of the school characteristics on

- The average achievement within schools;
- The effect of gender on achievement within schools, or the gap between boys' and girls' achievement within schools;
- The effect of race-ethnicity on achievement within schools, or the gap between minority and non-minority students' achievement within schools; and
- The effect of SES on achievement within schools, or the differentiating effect of SES on achievement within schools.

The effects of the school characteristics on mathematics and science achievement were similar by subject; they differed most often by grade. In general, the school characteristics examined in the analysis did better at explaining average achievement between schools than explaining the effects of gender, race-ethnicity, and SES on achievement.

Within schools, the effects of race-ethnicity and SES on science and mathematics achievement were consistent in all three grades studied, while the effect of gender varied. On average within schools, students from minority or low SES backgrounds tended to have lower scores on the NAEP tests, controlling for gender. The average within-school effect of gender on mathematics and science achievement varied by subject and grade. While there were essentially no differences in boys' and girls' mathematics and science achievement in the third grade or seventh grade mathematics, boys averaged higher scores than girls in seventh grade science and in both mathematics and science in the eleventh grade, controlling for race-ethnicity and SES.

Between schools, of all the school-level characteristics, the student body characteristics had the most associations with both average achievement and the effects of gender and SES.

However, no evidence of association was found between the student body characteristics and the effect of race-ethnicity. In both subjects and all three grades, the student body characteristics of percent black, percent Hispanic, and disadvantaged level of the students were consistently associated with lower average achievement. Still, there were variations by grade and subject. Being in a school with higher percentages of black students was associated with lower achievement in seventh grade than in third grade or eleventh grade in both subjects, while being in a school with higher percentages of Hispanic students was associated with a similar drop in achievement in all grades. Being in a school with more disadvantaged students was associated with lower average achievement in third grade, but in seventh and eleventh grade, the drop in achievement was significant but negligible. In all grades, these three variables were consistently associated with a larger drop in science achievement than mathematics achievement.

Two of the student body characteristics were associated with the effect of gender in third grade mathematics and with the effect of SES in seventh and eleventh grade mathematics and science. In schools with higher percentages of black students, girls tended to perform better than boys in third grade mathematics. In grades seven and eleven, SES had less of a differentiating effect on both mathematics and science achievement in schools with higher percentages of black and Hispanic students.

Controlling for the student body characteristics, some of the other school characteristics in the other four models were also associated with average achievement—four characteristics in grade three, four in grade seven, and six in grade eleven. In addition, four characteristics were associated with the effects of gender or race-ethnicity—one in grade three, one in grade seven, and two in grade eleven. Characteristics that explained average achievement usually varied by grade, but not often by subject. Within each grade, similar characteristics often explained both mathematics and science achievement. No other school characteristics were found to be associated with the effect of SES, and the few characteristics that were associated with the effects of gender and race-ethnicity varied by grade and subject.

In grade three, for both mathematics and science achievement, larger schools, team-taught classes, and classrooms organized by departments were associated with higher average achievement. In addition, for science achievement only, higher student/teacher ratios were associated with lower average science achievement. Higher student/teacher ratios were also associated with a gender gap between girls and boys in science—girls averaged lower science achievement scores than boys in schools with higher student/teacher ratios.

In grade seven, for both mathematics and science achievement, schools with mathematics tracking were associated with higher average achievement, while schools with higher numbers of positive changes in academic standards were associated with lower average achievement. In addition, for mathematics achievement only, schools with more instructional funds per student and schools that gave higher amounts of homework were associated with higher average mathematics achievement. For science achievement only, schools with more parent/teacher interactions were associated with a larger than average gap between girls and boys in science achievement—girls averaged lower science achievement scores than boys in these schools.

In grade eleven, for both mathematics and science achievement, schools with specialized science labs, with science tracking, and with larger amounts of homework given were associated with higher average achievement. In addition, for mathematics achievement only, schools with more instructional funds per student and larger schools were associated with higher mathematics achievement. However, larger schools were also associated with a larger gender gap in mathematics achievement—girls averaged lower mathematics achievement than boys in larger schools. Another factor associated with mathematics achievement was that in schools where teachers spent proportionally more time on academic tasks, blacks, Hispanics, and Native Americans averaged lower mathematics achievement than whites and Asians. In addition, for science achievement only, schools with general science labs were associated with lower average science achievement.

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I. Introduction

A. Background and Purpose

Over the last decade, research on "school effectiveness" has received a great deal of attention in scholarly journals and the popular press. Researchers, in an attempt to understand why some schools seem to be better able to produce positive educational outcomes than other schools, have attempted to relate specific school characteristics to student achievement. In so doing they have defined a wide range of possible school influences on academic performance. These include such factors as student body composition, socioeconomic status of students, structure of school facilities, financial conditions within the school, teacher characteristics and behavior, principal behaviors and experience, parental involvement, differentiation of school courses, and school values measures.

Earlier effective schools research focused on school structure variables such as equipment and funds distribution, while much of the current research has emphasized the non-fiscal aspects of the school environment.[1] Two broad categories of non-fiscal aspects of schools that have been included in effective schools research are social compositional factors and school social structure. Social composition variables include ethnic composition of the student body, SES of the student body, size of the student population, and attendance measures.[2]

School social structure include variables such as the degree of parental involvement, differentiation of student programs, student to staff ratios, various indices of teacher experience, and time allocations of principals and teachers (i.e., time allotted to academic vs administrative tasks). Early work by Brookover and his colleagues found school social structure variables to be particularly powerful predictors of educational achievement.[3] Along similar lines, Rutter and his colleagues at the Center for Effective Schools have shown that the amount of time teachers spend on instruction, the frequency of student-teacher interactions, and allotted time spent directly with students by both teachers and principals, clearly differentiate between low and high achieving students.[4]

While effective schools research provides compelling evidence that differences among schools are associated with different levels of student performance, this literature has also been criticized on several methodological grounds. One criticism is that most of the studies have based their conclusions solely on samples of urban schools. Thus, while painting a portrait of effective urban schools, the extant literature may not inform policy makers about all effective schools. Factors that may affect student achievement in large urban schools may not affect student achievement in all schools.

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[1] For a review of earlier school effectiveness research see T.L. Good and R.S. Weinstein, "Schools Make a Difference: Evidence, Criticisms, and New Directions," *American Psychologist* 41 (10) (1986): 1090-1097.

[2] For example, see S.E. Mayer and C. Jencks, "Growing Up in Poor Neighborhoods: How Much Does It Matter?," *Science* 243 (March, 1989).

[3] W.B. Brookover, C. Beady, P. Flood, J. Schweitzer, and J. Wisenbaker, *School Social Systems and Student Achievement: Schools Can Make a Difference* (New York: Praeger, 1979).

[4] M. Rutter, "School Effects on Pupil Progress: Research Findings and Policy Implications" in *Handbook of Teaching and Policy*, eds. L. Schulman and G. Sykes (New York: Longman, 1983): 3-41.

Another criticism is that much of this research has not adequately modeled the hierarchical nature of student achievement data. That is, student achievement is not only affected by students' individual characteristics but is also affected by their shared experiences with fellow students within their schools. Therefore, by their very nature, questions about school effects require the exploration of within- and between-school relationships. Earlier research has relied primarily on simple multiple regression to assess school effects, and has therefore failed to adequately model the multilevel structure of these relationships. This may have led researchers to misleading conclusions about the effect (or non-effect) of various aspects of the school environment on student achievement.[5]

The purpose of this analysis is to address some of the methodological criticisms of the effective schools literature by capitalizing on recent developments in the statistical theory of hierarchical linear models (HLM). HLM allows direct representation of the influence of school factors within schools and directly models the hierarchical nature of the data. This report also overcomes the sampling weaknesses of earlier effective schools research by using a national representative sample of all public schools—urban, suburban, and rural— surveyed by the National Assessment of Educational Progress (NAEP).

This analysis is an exploratory effort to demonstrate the potential usefulness of a state-of-the-art procedure with a complex data set. Due to limitations of the data as well as the exploratory nature of the study, policy changes are not recommended on the basis of this report. Instead, researchers are encouraged to use this analysis as the basis for an understanding of the procedures and questions involved in using NAEP data and hierarchical linear models for school effectiveness studies.

The next section in this chapter briefly describes the data sources and the variables used for this analysis. A third section outlines the methodological approach used in the analysis. The following chapters present the results of the analysis, first for mathematics and then for science. The report ends with a discussion the findings of this analysis and the implications for the use of NAEP data and hierarchical linear models in school effectiveness research. The technical notes in Appendix A provide detailed information on the variables used and on the HLM methodology and statistics. Appendix B contains supporting tables of the descriptive and HLM results.

B. Data Sources and Variables

This analysis uses data from the 1985-86 National Assessment of Educational Progress (NAEP) in mathematics and science. The primary goals of NAEP are to detect and report the current status of, as well as changes in, the educational attainments of young Americans. To accomplish these goals, NAEP biennially selects large, nationally representative samples of students and gathers a vast amount of information about the students and their schools. This report uses the 1985-86 NAEP in mathematics and science to examine the relationship between school-level data and individual student-level math and science test data for a nationally representative sample of third, seventh, and eleventh graders in public schools. Scores on math and science proficiency are available for about 90,000 students in the main 1985-86 NAEP assessment. A school characteristics and policies questionnaire was distributed to each sampled school. About 87 percent of schools completed these questionnaires.[6]

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[5] For an early warning on the dangers of using single-level models to model school effects see L. Cronbach, *Research on Classrooms and Schools: Formulation of Questions, Design, and Analysis* (occasional paper of the Stanford Evaluation Consortium, Stanford, CA: Stanford University, 1976). For a review of the early methods used to model multilevel data, see L. Burstein, "The Analysis of Multilevel Data in Educational Research and Evaluation," *Review of Research in Education* 8 (1980): 158-233.

The outcome measures used in this analysis are the composites of the subscales NAEP produced to represent overall proficiency in mathematics and science. These overall estimates of a student's mathematics and science proficiency are weighted averages of his or her proficiency estimates for the several original NAEP subscales. Descriptions of the subscales for mathematics and science are provided in *Expanding the New Design: The NAEP 1985-86 Technical Report.*[7]

The variables from the NAEP dataset used in this analysis are listed in table 1. A full description of these variables and their construction is provided in the technical notes in Appendix A.

Table 1.--Variables used in the analysis

Student-level variables

- Gender
- Race-ethnicity (black, Hispanic, or American Indian versus white or Asian)
- Socioeconomic status

School-level variables

Student body characteristics

- Percentage of student body that is black
- Percentage of student body that is Hispanic
- Index of disadvantaged students in the student body

Fiscal and Physical Characteristics of the School

- Instructional funds per student
- Number of microcomputers per student
- Science lab facilities in classroom (yes/no)
- General purpose science labs (yes/no)
- Specialized science labs (yes/no)

School Program Structure

- Math tracking in this grade – Grades 7, 11 (yes/no)
- Science tracking in this grade – Grades 7, 11 (yes/no)
- Student/teacher ratio
- School size in number of students

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[6] HLM requires full data on school-level variables. Therefore, students whose school failed to return the school and/or principal questionnaire were dropped from the analysis. HLM does not require full data on student-level variables. Students without full data were included in the analysis. However, if all students in a school were missing any variable, the school and its students were dropped from the analysis.

[7] A. Beaton, *Expanding the New Design: The NAEP 1985-86 Technical Report* (Princeton, New Jersey: Educational Testing Service, November, 1988).

Table 1.--Variables used in the analysis--Continued

Classroom Organization in this grade:
  Self-contained classrooms(yes/no)
  Team-taught classrooms (yes/no)
  Departmentalized classrooms (yes/no)

School Academic Standards

Index of rigor of current standards
Index of change in standards
Amount of homework assigned
Index of teacher control over academic standards

Principal and Teacher Characteristics

Principal years as principal of that school
Principal years of educational administration experience
Principal years of prior teaching experience
Index of principal time spent on academic tasks
Amount of principal time spent in parent/community relations
Percentage of teachers who are minority group members
Index of teacher time spent on academic tasks – Grades 7, 11
Index of parent/teacher interaction

Two levels of independent or explanatory variables were created: student-level and school-level. The student-level variables are gender, race-ethnicity, and socioeconomic status (SES). Many of the school-level variables are composite variables representing aspects of the school environment that have been shown in the school effectiveness literature to be related to student achievement.[8] Five such characteristics that can be measured in the NAEP dataset were identified: student body characteristics, fiscal and physical characteristics of the school, school program structure, school academic standards, and principal and teacher characteristics.

The literature on effective schools indicates that while earlier research emphasized the financial and physical characteristics of schools, most current studies have focused on non-fiscal school characteristics. To the degree possible with the NAEP data, this analysis included variables measuring both the fiscal and non-fiscal aspects of schools. Two broad categories of non-fiscal aspects of schools used in this report were social compositional factors and school social structure. Social composition variables included race and ethnic composition of the student body, SES of the student body, and size of the student population. School social structure included variables such as the degree of parental involvement, differentiation of student programs, student to staff ratios, various indices of principal experience and teacher characteristics, and time allocations of principals and teachers (i.e., time allotted to academic vs. administrative tasks).

NAEP is cross-sectional, rather than longitudinal data, so in using it to look at the relationship between schools and student achievement, certain assumptions need to be made. In this study, it was assumed that students had been in their respective schools long enough for that school to have had an impact on their achievement. This assumption was most likely to be true for the students in grades three and eleven because most of them would have been in the same school (i.e., elementary or high school) during the previous year or so, unless their parents moved. However, the students in grade seven would have been in the same school in previous years only if they attended an elementary school that included seventh grade or a middle or combined school that started earlier than seventh grade. If they were in their first year of a new middle or high school, this assumption may not have held for them.

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[8] A discussion of the creation and reliabilities of these variables is presented in the technical notes.

C. Methodological Approach

This section outlines the methodological approach used in this analysis. Presented first is a general discussion of the statistical technique used. This is followed by a more specific discussion of how the technique was applied in this analysis. Next is presented the model-building strategy used for this report. Finally, a special analytical consideration in using the NAEP dataset is discussed, and the manner in which it was handled in this paper is outlined. The HLM methodology is discussed in more detail in the technical notes in Appendix A.

Hierarchical Linear Models

The data collected under NAEP is hierarchical in nature, that is, students are nested within schools.[9] The mismatch between the hierarchical character of this type of data and traditional single-level analytical models has led to persistent methodological problems in educational research.[10] Traditionally, researchers have analyzed such data at the individual level, ignoring the higher-level unit, the school. This creates problems due to the fact that two children within the same school will be more alike than two children from different schools, even when they are in the same treatment condition. Treating these data as if they were from a simple random sample can lead to misleading inferences from both a logical and statistical perspective. However, with the recent development of hierarchical linear models, many of the problems with assessing multi-level effects have been overcome.[11]

Hierarchical linear models directly address the problem of students nested within schools by directly modeling within- and between-school variation in achievement. These models allow us to explain student achievement as a function of school-level effects. In addition, HLM allows the examination of the impact of school characteristics on the relationship between student characteristics and achievement within schools. The analysis uses a two-level HLM microcomputer program developed by Anthony Bryk, Stephen Raudenbush, and Richard Congden.[12]

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[9] To be more exact, students are nested within classrooms within schools. However, there were not enough students per classroom in the NAEP sample to analyze classroom differences. Therefore, this methodological discussion will focus on the student-level and school-level differences that were analyzed in this report.

[10] This is sometimes referred to as the unit of analysis problem.

[11] A.S. Bryk and S.W. Raudenbush, "Towards a More Appropriate Conceptualization of Research on School Effects: A Three-Level Hierarchical Linear Model" in *Multilevel Analysis of Educational Data*, ed. R.D. Bock (San Diego, CA: Academic Press, 1989): 159-204; S.W. Raudenbush and A.S. Bryk, "A Hierarchical Model for Studying School Effects," *Sociology of Education* 59 (January, 1986): 1-17; and A.S. Bryk and S. W. Raudenbush, *Hierarchical Linear Models for Social and Behavioral Research: Applications and Data Analysis Methods* (Newbury Park, CA: Sage, in press).

HLM Analysis of NAEP data

The purpose of this study was to estimate the school effects for six subject/grade combinations—math achievement in grades three, seven, and eleven, and science achievement in grades three, seven and eleven. Separate analyses were run for each grade level (three, seven, and eleven) within each subject area (math and science.) Each of the following steps were performed for each subject/grade combination. In the first step, the within-school models were estimated using ordinary least squares regression analysis. Achievement was modeled at the student level within each school as a function of the student characteristics—gender, race-ethnicity, and SES. This resulted in an equation for each school that consisted of regression coefficients (called Betas in HLM) that estimated the effect on achievement of being female, of being a minority, and of SES level. The equation also estimated an intercept, which represented the average achievement in the school.

The regression coefficients from the first step in the analysis became the outcome measures in the second step. That is, in the next step in the analysis, the variation in these within-school parameters—the intercept and the Betas—was examined. Each of these parameters was used as a dependent variable in a separate equation and their variation was modeled as a function of the school-level characteristics across schools. These between-school equations produced coefficients (called Gammas in HLM) that estimated the effect of each school-level characteristic on either the average achievement, the effect of gender on achievement, the effect of race-ethnicity on achievement, or the effect of SES on achievement in the schools.

It is the coefficients, or Gammas, from these four between-school equations that were the major indicators of school effects on achievement and of school effects on the effects of gender, race-ethnicity, and SES. For example, the intercept equation measured the effect of school characteristics, such as number of computers per student, on the average achievement in schools. Did schools with a higher number of computers have higher average achievement levels? The gender parameter equation measured the effect of school characteristics, such as the number of computers per student, on the gap in achievement between females and males, a gap that varied between schools. Did schools with a larger number of computers have a smaller or larger gap in achievement between females and males? In the race-ethnicity parameter and SES parameter equations, the questions were: Were the school-level characteristics in the models associated with a smaller or larger gap between minorities and whites/Asians and a smaller or larger effect of SES level on achievement?

All the school-level characteristics, or variables, were standardized, so their values were in standard deviation units from their mean. The Gammas based on these variables from the between-school equations were then interpreted as the effect on the dependent parameter of each school-level variable for every standard deviation above the mean of that variable. This allowed the school effects, or Gammas, on these variables to be comparable across variables within subject and grade. The size of these school effects could then be directly compared between variables.

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[12] A.S. Bryk, S. W. Raudenbush, M. Seltzer, and R. Congdon, *An Introduction to HLM: Computer Program User's Guide (Second Ed.)* (Chicago, IL: University of Chicago, Department of Education, 1988). Bryk, Raudenbush, and Congden modified their program to allow the special weighting used in this analysis. See the technical notes for a full discussion of the weights used here.

In addition, the student-level variables were centered, i.e., their school means were subtracted from them. This allowed the intercept to be interpreted as the average achievement in each school, the effect of gender to be interpreted as the gap between girls and boys (the "gender gap") in each school, and the effect of race-ethnicity to be interpreted as the gap between minorities and whites/Asians (the "minority gap") in each school. Since SES already had a zero mean, the effect of SES could be interpreted as indicating the extent to which SES was associated with achievement in each school.

Other statistics produced by the HLM analysis are also helpful in interpreting the within-school parameters and the between-school models. For each of the four within-school parameters—intercept, gender, race-ethnicity, and SES—in each model, HLM provides the parameter variance, called Tau, a test of whether Tau is greater than zero, and the reliability, the percentage of the total variance around each parameter that is represented by parameter variance.

Parameter variance, or Tau, is the actual variation between schools around the parameters of the intercept and the gender, race-ethnicity, and SES coefficients in the within-school equations. The parameter variance usually changes between models. It is highest in the average within-school models, where it indicates how much variance there is around each of the four parameters before any between-school variables are taken into account. The purpose of the between-school models is to explain, or reduce this parameter variance. A measure of how well each model explains the parameter variance is the R^{2*}. It is similar to a linear regression R^2, in that it represents the proportion of the original parameter variance that was explained by a particular between-school model.

In this report, the Gammas and the R^{2*} are presented and discussed in the results chapters, and more information about them is also provided in the technical notes in Appendix A. The reliability, parameter variance, and the test for whether Tau is greater than zero are discussed in the technical notes and presented in the technical tables in Appendix B.

Model Building

In this study, the school-level characteristics, or variables, were not entered into the between-school model simultaneously. Instead, they were entered in five separate models, reflecting the five groups of school effects that were deemed to be of theoretical importance based on previous school effects research. The variables in the first model, the student body characteristics, were included in all subsequent models as controls.

For both theoretical and practical reasons, five separate models were developed rather than creating one model of all the variables and eliminating variables until one final model of the most significant variables was left. Dividing the variables into five models avoided over-controlling with too many variables and obscuring some effects that might be significant. Grouping the variables into theoretical models allowed each distinct concept to be tested, controlling for student body characteristics, using related variables as controls whether or not they were significant. This provided more theoretically coherent models. Extracting the significant variables from each model and running them in a final model would have removed them from their theoretical context and controls, and would have been theoretically and statistically less justifiable. In addition, HLM PC version could not test more than 34 total variables in each model.

Before the between-school models were tested, the within-school models were run. These models tested how well the within-school variables predicted achievement within each school, and provided the parameters that would be the dependent variables in the between-school models. Then the between-school models containing the school-level variables were tested. These are numbered from Model 1 to Model 5 in the text. Model 1 tested variables related to the student body composition of the schools. Model 2 tested fiscal and physical characteristics of the schools. Model 3 tested variables related to the school program structure of student, teacher, and classroom organization in the schools. Model 4 tested academic standards in the schools. Model 5 tested principal and teacher characteristics in the schools.

Variables were added to the between-school models in small groups within each model. Because of software limitations, not all of the variables in each model could be entered at once (see the technical notes). Therefore, if individual variables were significant or had continuing theoretical importance, they were retained. Otherwise, they were dropped and the next group of variables was added. Since different variables were significant for each dependent Beta parameter and each subject/grade combination, the final models resulted in different variables, or equations, for each dependent Beta parameter and each subject/grade combination. Variables not in the final model were either not available for that grade (see the variable list in table 1) or had been included in previous models, found insignificant, and dropped.

Special Analytical Consideration in NAEP

The 1985-86 Mathematics and Science Assessment employed a variant of matrix sampling called balanced incomplete block (BIB) spiraling. With this procedure, the total assessment battery is divided into several 14-minute blocks of items as well as a 6-minute block of background characteristic items common to all students at that grade level. Each student was administered a booklet containing three blocks as well as a 6-minute block of background questions. The BIB part of the method assigns blocks of items to booklets in such a way that each pair of blocks appears in at least one booklet. This generates a large number of different booklets. The spiraling part of the method then cycles the booklets for administration, so typically no two students in any assessment session in a school, and at most only a few students in schools with multiple sessions, receive the same booklet. At each age/grade level, each block of items was administered to approximately 2,000 students and each pair of blocks to approximately 200 students.

Item response theory (IRT) was then used to estimate proficiency scores for each individual student. However, these proficiency scores are latent variables conditional on the student's responses to several cognitive and background items and *are not directly observed*. That is, proficiency scores were predicted from a set of cognitive and background variables (referred to as conditioned variables). Because the proficiency scores are not observed but estimated, there is some amount of uncertainty or variance associated with them. Thus, rather than having a single observed math or science score, there is a range or distribution of plausible values for each sampled student's proficiency in mathematics and science.

In this analysis there are five such plausible values for each sampled student resulting from five random draws from the conditional distribution of proficiency scores for each student. The point estimations in the descriptive tables in Appendix B are based on the simple average of all five plausible values. The parameter estimates from the HLM analyses shown in the text tables and supporting tables are based on the average parameter estimates from separate HLM analyses of the five plausible values. That is, separate HLM analyses were conducted on each of the five plausible values and the results from these analyses were averaged.[13]

Studies by ETS have shown that statistics that involve variables that were included in the imputation of the plausible values for student proficiency scores are consistent estimators of population values. However, statistics involving background variables that were not used in the imputation of the plausible values have been shown to be biased. In particular, analyses of reading proficiency scores in the 1984 NAEP Reading Assessment indicated that multiple regression coefficients for non-conditioned variables tend to be underestimated by an average of 30 percent.[14] However, while underestimating the effects of non-conditioned variables, the direction of effects of non-conditioned variables are almost always correct. Unfortunately, most of the school-level variables used in the composite variables created in this analysis are non-conditioned variables, i.e. they were not used in the imputation of the plausible values. Therefore, while the analysis of these variables has correctly informed us on the direction of their effects, the size of these effects may have been underestimated by some unknown amount.

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[13] See the technical notes for a full discussion of how the HLM parameter estimates and their standard errors were calculated for this report.

[14] R. J. Mislevy, *Randomization-Based Inferences About Latent Variables From Complex Samples* (Princeton, New Jersey: Educational Testing Service, September 1988).

II. School Effects on Mathematics Achievement

A. Within-School Models

This analysis involved three within-school variables: gender, race-ethnicity, and socioeconomic status (SES).[15] To assess the independent effect of the within-school variables, a regression equation was computed within each school predicting students' math achievement by the students' gender, race-ethnicity, and SES. Thus, each school had separate estimates (or Beta coefficients) for these effects on math achievement. In addition, each school had a separate intercept term, or, in this case, a separate estimate of the average math achievement in that school.

Table 2.--Average within-school predictors of math achievement, grades 3, 7, and 11

Predictor	Grade 3	Grade 7	Grade 11
INTERCEPT (AVG. ACHIEVEMENT)	208.29**	269.66**	298.03**
GENDER COEFFICIENT	-0.85	0.23	-2.78**
RACE-ETHNICITY COEFFICIENT	-14.63**	-16.06**	-19.32**
SES COEFFICIENT	10.95**	12.84**	14.27**

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

The averages of these within-school equations for grades three, seven, and eleven math achievement are shown in table 2.[16] The average intercept among all the third, seventh, and eleventh grade schools was 208.29, 269.66, and 298.03 respectively. These values are the average achievement scores across third, seventh, and eleventh grade schools. The beta coefficients for gender, race-ethnicity, and SES in these equations represent the average gap in achievement between boys and girls (the gender gap), the average gap in achievement between minority and non-minority students (the minority gap), and the differentiating effect of SES on mathematics, respectively. For example, in grade three, the average coefficient for gender is not significantly different from zero. Therefore, on average across third grade schools, if one controlled for race-ethnicity and SES, girls did no better or worse than boys in mathematics. The average coefficient in grade three for race-ethnicity is -14.63, signifying that there was a 14.63 point gap in math achievement between the minority and non-minority students, with the minority students doing less well. The average coefficient for SES among third grade schools was 10.95, and is significantly different from zero. Since SES has a mean of zero and a standard deviation of one, on average across schools, students one standard deviation above average SES levels are expected to score 10.95 points higher in math achievement than students of average SES. In a similar fashion, students one and one-half standard deviations below average SES are expected to score 16.42 points lower (1.5*10.95) than students of average SES. When the SES coefficient is significant such as in this case, it can be seen as having a differentiating effect on achievement because students are predicted to have different levels of achievement based on their SES.

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[15] The race-ethnicity variable was a dummy variable with the values of minority and non-minority students. Minority students were black, Hispanic, or American Indian. Non-minority students were white or Asian. The rationale for grouping Asian students with white students is presented in the technical notes. The SES variable was a standardized composite variable of mother's education, father's education, and the presence of six material possessions in the home, including a computer. See technical notes for more information.

[16] These averages of the coefficients are weighted in HLM by the inverse of the precision of their within-school estimates, so that coefficients from schools with smaller samples and less precise estimates are given less weight.

These equations indicate that on average for each grade, minority students performed worse than did non-minority students, controlling for gender and SES. This gap between the minorities and the others was wider in grade seven than grade three, and wider in grade eleven than grade seven. Likewise, in all three grades, SES, controlling for gender and race-ethnicity, had a differentiating effect in that students of higher SES did better than students of lower SES. This effect of SES also was stronger in the higher grades than in the lower grades. Gender, controlling for SES and race-ethnicity, on average was not associated with student math achievement in grade three or grade seven. However, in grade 11, on average, girls did less well than boys, controlling for race-ethnicity and SES.

These equations represent the average math achievement in the schools and the average relationship within schools between math achievement and gender, race-ethnicity, and SES. However, these relationships and average achievement actually varied quite a bit between schools. For example, in grade seven, while average math achievement across all the schools was 270 points, the average achievement within schools varied from a minimum in a school with an average achievement score of 235 points, to a maximum for a school with an average achievement score of 295 points. The relationship between gender and math achievement in grade seven also varied between schools. While the average difference between girls and boys across all the schools was less than 1 point, in some schools girls averaged higher scores than boys and in other schools boys averaged higher scores. In most schools, this average difference between girls and boys was less than 10 points, although in some schools it was more. Similarly, while the average relationship between race-ethnicity and grade seven math achievement was a 16-point lower score for minorities than for whites and Asians, this relationship also varied between schools. While in most schools, minorities averaged lower scores than whites and Asians, in ten percent of the schools minorities averaged higher scores than whites and Asians. The effects of SES also varied between schools. In most schools, SES was positively correlated with achievement so that on average across schools, higher SES students scored 13 points higher than students from average SES, and lower SES students scored 13 points lower than average SES students. However, in about ten percent of the schools, SES was not correlated with achievement, and for a few schools it was negatively correlated in that higher SES students tended to have lower than average scores, and lower SES students tended to have higher than average scores.

The purpose of the between-school models was to explain the variation in these average achievement scores and in these relationships. What characteristics in schools were associated with higher or lower average math achievement in a school? What school characteristics were associated with stronger or weaker relationships between gender, race-ethnicity, or SES and math achievement in a school? In Models 1-5, each of the coefficients and the intercept became a dependent variable in a between-school regression equation that predicted their value based on school-level characteristics.

B. Between-School Models

The between-school models tested groups of school-level variables in four regression equations whose dependent variables were the intercepts and the coefficients of gender, race-ethnicity, and SES from the within-school math achievement equations. Each model tested the association of a group of related variables with each of the four dependent variables. Model 1 tested variables related to the student body composition of the schools. Model 2 tested fiscal and physical characteristics of the schools. Model 3 tested variables related to the school program structure of student, teacher, and classroom organization in the schools. Model 4 tested academic standards in the schools. Model 5 tested principal and teacher characteristics in the schools. The results of each of these math achievement analyses are presented below for each grade. A summary of the findings from all of these analyses follows this presentation. This summary includes a discussion of the proportion of parameter variance explained by each model. These proportions are shown in table 8.

Model 1: Student Body Characteristics

Model 1 tested variables related to the student body composition in the schools—the percentage of the students who were black and who were Hispanic in each school, and the disadvantaged level of students in each school as a whole. The results are shown in table 3 for grades three, seven, and eleven. There were four between-school equations for each grade—one for each of the parameter estimates in the within-school equation. Each equation used the three student body characteristics variables to predict the following Beta parameters from the within-school equations:

- the intercept or average math achievement in a school;
- the gender coefficient or the gap between boys' and girls' math achievement;
- the minority coefficient or the gap between minority and non-minority students' math achievement; and
- the SES coefficient or the differentiating effect of SES on math achievement.

This resulted in four terms in each between-school equation: an intercept term and a Gamma parameter for percent black, percent Hispanic, and the disadvantaged level of the school. The results from these equations are described below for each grade.

Grade three. The results for the equation predicting average achievement indicate that, controlling for percent Hispanic and the disadvantaged level of a school, for every standard deviation above the average percentage of blacks in a third grade school, average math achievement in that school was 8.2 points lower. Furthermore, controlling for percent black and disadvantaged level, for every standard deviation above the average of percentage of Hispanics in a school, average math achievement in that school was 4.3 points lower. Finally, controlling for percent black and percent Hispanic, for every standard deviation above the average disadvantaged level of a school, average math achievement in that school was 7.2 points lower. Thus, controlling for each other, these student body characteristics were all negatively associated with average math achievement in schools. As shown in table 8, this model explained two-thirds of the variance in average achievement.

The gender coefficient shown in the within-school equation was not significantly associated with the percentage of Hispanic students in a school or the level of disadvantaged in a school. After controlling for these between-school variables there continued to be no gap, on average, between boy's and girl's achievement in third grade math, as shown by a non-significant intercept. However, girls did better than boys in schools with higher percentages of blacks. That is, for every standard deviation above the average percentage of blacks in a school, the girls averaged better in relation to boys by 2.1 points, controlling for percent Hispanic and the disadvantaged level of a school. However, as shown in table 8, only 12 percent of the variance in the gender gap was explained by this model.

Table 3.--Effects of student body characteristics on predictors of math achievement, grades 3, 7, and 11

Effect[1]	Grade 3	Grade 7	Grade 11
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	209.43**	261.54**	298.96**
Percent black	-8.19**	-11.39**	-8.84**
Percent Hispanic	-4.34**	-5.22**	-4.99**
Disadvantaged Level	-7.21**	-1.33*	-1.84*
ON GENDER COEFFICIENT			
Intercept	-1.23	1.00	-2.90**
Percent black	2.13*	-0.99	-0.18
Percent Hispanic	-0.85	-1.05	-0.96
Disadvantaged level	0.73	-0.36	-1.05
ON RACE-ETHNICITY COEFFICIENT			
Intercept	-14.87**	-15.13**	-19.42**
Percent black	-2.12	-0.13	-0.72
Percent Hispanic	0.10	1.18	0.67
Disadvantaged level	2.96	-2.45	2.41
ON SES COEFFICIENT			
Intercept	11.02**	12.31**	14.41**
Percent black	0.51	-3.65**	-1.61
Percent Hispanic	-0.01	-2.06**	-2.75**
Disadvantaged level	-2.25	-0.70	-0.84

[1] All between-school independent variables have been standardized. See technical notes for more information.

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

In the race-ethnicity equation, the minority coefficient from the within-school equation was not significantly associated with the percentages of black or Hispanic students, or the disadvantaged level in a school, controlling for each other. Instead, the minority gap in math achievement remained at 14.9 points, controlling for these student body characteristics, as shown by a significant intercept. Not surprisingly, this model explained little of the variance in the minority gap (table 8).

In the SES equation, the SES coefficient from the within-school equation was not significantly associated with the percentage of blacks, the percentage of Hispanics, or the disadvantaged level in a school, controlling for each other. Consequently, little of the variance in the differentiating effect of SES was explained by this model (table 8). As shown by the significant intercept, the differentiating effect of SES in math achievement remained at 11 points for every standard deviation of SES above or below the average of SES, controlling for the student body characteristics.

In summary for grade three math achievement, there is strong evidence for association between student body characteristics and average achievement in a school, because all variables in the model were significant, and a high proportion of variance was explained. However, except for the association of higher percentage of black students with the higher achievement of girls in relation to boys, there was no evidence of association between student body characteristics and the effects of gender, race-ethnicity, or SES on achievement within schools. That is, these effects seem to be constant across schools with differences on these characteristics. In addition, this model explained little of the variance in the gender, race-ethnicity, or SES effects.

Grade seven.[17] Grade seven yielded similar results to those seen in the third grade. Student body characteristics appear to have strong negative associations with average math achievement in a school. However, while a higher percentage of black students predicted a greater drop in average achievement than in grade three, the drop in average achievement predicted by percent Hispanic was similar to grade three. The disadvantaged level of a school was also associated with lower average achievement, but the drop in achievement was very small compared to grade three—for every standard deviation above the average disadvantaged level, average math achievement was only 1.3 points lower. As in grade three, two-thirds of the variance in average achievement was explained by this model (table 8).

Unlike grade three, in grade seven there was no evidence of association between the percentage of blacks in a school and the achievement of girls in relation to boys. Instead, none of the student body characteristics were significantly associated with the effects of either gender or race-ethnicity, and this model explained little of the variance in these effects.

However, there were associations of percent black and percent Hispanic with the effects of SES on achievement—the higher the percentage of black and Hispanic students, the less of a differentiating effect SES had on math achievement within schools.[18] As shown in table 8, one-third of the variance in the effects of SES was explained by this model.

Grade eleven. In grade eleven, all the student body characteristics were significantly associated with average math achievement in a school, and one characteristic was associated with the effect of SES on achievement. The drop in average math achievement predicted by percent black was not as large as in grade seven and was similar to the grade three result. The drop in average math achievement predicted by percent

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[17] Throughout this analysis the parameter variance (or the Tau's) for grade seven math and science were lower than those for the other grades. After ruling out computer or human error in the analysis, this systematically lower parameter variance remains somewhat of a mystery.

[18] One explanation for this result is that schools with higher minority populations might have a more limited and lower range of SES levels among the students than other schools. Therefore, SES might not have provided enough variation to register an effect. However, if this is the case, it is puzzling why schools with higher disadvantaged levels did not have fewer effects of SES as well.

Hispanic was similar in size to grade three and grade seven. As in grade seven, the disadvantaged level of a school was associated with only a small drop in average achievement. However, only half of the variance in average achievement was explained by this model in this grade.

In grade eleven, there was no evidence of associations between the student body characteristics and the effects of gender and race-ethnicity on achievement within schools. As in grade three and grade seven, these effects seem to be constant across schools with differences on these characteristics. As in grade seven, there was an association between percent Hispanic and the effects of SES on achievement—the higher the percentage of Hispanic students, the less of a differentiating effect SES had on math achievement within schools. This result might also be due to a limited range of SES levels in schools with higher Hispanic populations. However, the effect of SES was not associated with percent black or the disadvantaged level in the school. Despite the one significant variable, little variance in the effects of gender, race-ethnicity, or SES was explained by this model (table 8).

Models 2-5

Models 2 through 5 tested various groups of variables to see if they could explain the variation in the within-school equation intercept and coefficients that predicted math achievement. Included in each of these models as controls were the student body characteristic variables of percent black, percent Hispanic, and disadvantaged level of a school. Their effects remained similar in each model, and they are not reported here in order to focus attention on the new variables in Models 2 through 5.

Model 2: Fiscal and Physical Characteristics

Model 2 tested variables related to the fiscal and physical characteristics of schools—the instructional funds spent per student, the number of microcomputers per student, and whether or not a school had classroom science labs, general science labs, and specialized science labs. The results are shown in table 4 for grades three, seven, and eleven.[19]

Grade three. Controlling for the student body characteristics, the fiscal and physical school characteristic variables did not appear to have a significant association with average achievement in a school nor with the effects of gender, race-ethnicity, or SES on achievement within schools. In addition, the proportion of variance explained by this model did not rise above the level already explained by the student body characteristics for any of the four equations (table 8).

Grade seven. In grade seven, one fiscal or physical school characteristic was significantly associated with average math achievement, controlling for student body characteristics. Schools that had instructional funds per student one standard deviation above the average had average math achievement scores of 1.7 higher than other schools. However, this model did not explain any more variance than the two-thirds already explained by the student characteristic variables. Fiscal and physical school characteristics did not have any association with the effects of gender, race-ethnicity, or SES on achievement within schools. In addition, the proportion of variance explained remained at the same low level for the effects of gender and race-ethnicity (table 8). However, due to the inclusion of the student body characteristics, the model continued to explain one-third of the variance in the effects of SES.

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[19] In these and the following tables some variables in the model were tested and found nonsignificant and were dropped from the final model. Variables not in the table or variables with no coefficients in the tables were not in the final model in that particular grade, but were tested in earlier models and found nonsignificant. Variables with coefficients in the tables were in the final model, and if the coefficients were significantly different from zero, they are noted with asterisks.

Table 4.--Effects of fiscal/physical school characteristics on predictors of math achievement, controlling for percent black, percent Hispanic, and disadvantaged level, grades 3, 7, and 11

Effect[1]	Grade 3	Grade 7	Grade 11
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	209.27**	261.79**	300.01**
Instructional funds/student	-0.17	1.72**	2.10**
Microcomputers/student	0.89	-0.58	0.36
Have general science lab		0.54	-1.65
Have specialized science lab	0.03	0.63	3.83**
ON GENDER COEFFICIENT			
Intercept	-1.76	1.24	-2.93**
Instructional funds/student	-1.68	-0.07	0.02
Microcomputers/student	0.09	0.49	-0.35
Have specialized science lab	0.14	0.59	-0.90
ON RACE-ETHNICITY COEFFICIENT			
Intercept	-15.12**	-14.87**	-18.64**
Instructional funds/student	-0.20	0.46	0.65
Microcomputers/student	1.54	0.04	-0.43
Have specialized science lab	-0.96	-1.02	0.06
ON SES COEFFICIENT			
Intercept	10.95**	12.49**	14.31**
Instructional funds/student	-0.64	0.50	0.45
Microcomputers/student	0.97	-0.17	1.03
Have specialized science lab	-1.05	-0.27	0.06

[1] All between-school independent variables have been standardized. See technical notes for more information.

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

Grade eleven. In grade eleven, two fiscal or physical school characteristics had significant associations with average math achievement. Again, schools with more funds per student averaged slightly higher math scores. In addition, schools with specialized science labs had average math achievement scores of 3.8 points higher than schools without them, controlling for the student body characteristics and the other fiscal and physical characteristics. This model did raise the proportion of variance explained from 53 to 60 percent (table 8). However, none of the characteristics were associated with the effects of gender, race-ethnicity, or SES on math achievement within schools, and the proportion of variance explained by this model remained very low for these effects.

Model 3: School Structure of Student, Teacher, and Classroom Organization

Model 3 tested variables related to the structure of student, teacher, and classroom organization in the schools—the student/teacher ratio, the school size in number of students, and whether the classrooms in this grade were organized as self-contained classes, team-taught, or organized as departments. The classroom organization variable consisted of a group of dummy variables indicating whether classrooms were self-contained, team-taught, or organized departmentally. Since most of grade three classrooms were self-contained, that was the reference category for that grade. For grades seven and eleven, the reference category was departmental, since most were organized in that way. In addition, two additional variables were tested for grades seven and eleven—whether there was math tracking in that grade, and whether there was science tracking in that grade. The results are shown in table 5 for grades three, seven, and eleven.

Grade three. For the equation predicting average math achievement, three of the new variables for this model were significant. The school size in number of students and whether the classrooms in this grade were team-taught or organized as departments were significantly associated with average math achievement in schools, controlling for the student body characteristics. Schools with a higher than average number of students averaged math scores of 1.9 points higher. Schools with team-taught classes in grade three or those organized into departments had similar higher average achievement scores. However, none of these variables were significantly associated with the gender, race-ethnicity, or SES coefficients from the within-school equation. As shown in table 8, the variance explained by this model was similar to that explained by previous models. Over two-thirds of the variance on average achievement was explained, but little variance in the effects of gender, race-ethnicity, or SES was accounted for.

Grade seven. In grade seven, only one school structure variable had any association with average math achievement in a school, controlling for student body characteristics. Schools with math tracking had higher average math scores by 1.5 points. However, none of the school structure variables were significantly associated with the gender, race-ethnicity, or SES coefficients from the within-school equation. As with earlier models, the proportion of variance explained by this model remained over two-thirds (70 percent) for average achievement, over one-third (37 percent) for the effects of SES, and very low (9 percent and zero) for the effects of gender and race-ethnicity (table 8).

Grade eleven. In grade eleven, two school structure characteristics were associated with average math achievement in schools, and one of these characteristics was associated with the effects of gender on math achievement within schools. Similar to grade seven, schools with science tracking rather than math tracking had higher average math scores by 1.8 points. In addition, schools with a higher than average school size (in number of students) had higher average math achievement scores of 3.6 points. As shown in table 8, the proportion of variance in average achievement explained by this model remained at 60 percent.

Table 5.--Effects of school structure characteristics on predictors of math achievement, controlling for percent black, percent Hispanic, and disadvantaged level, grades 3, 7, and 11

Effect[1]	Grade 3	Grade 7	Grade 11
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.98**	261.33**	298.74**
Math tracking		1.51*	
Science tracking			1.75*
Student/teacher ratio	-1.09	-1.14	0.34
School size (number of students)	1.87*	1.05	3.62**
Classroom organization:			
Team-taught classes	1.53*		
Departmental structure	1.35*		
ON GENDER COEFFICIENT			
Intercept	-1.32	0.93	-2.63**
Math tracking			0.97
Student/teacher ratio	-0.50	-0.94	1.23
School size (number of students)	1.43	0.49	-2.13*
ON RACE-ETHNICITY COEFFICIENT			
Intercept	-14.72**	-15.22**	-19.63**
Student/teacher ratio	-0.50	-0.57	-0.59
School size (number of students)	0.89	-0.10	0.65
Classroom organization:			
Team-taught classes	-0.16	-1.77	
Departmental structure	-0.96		
Self-contained classrooms		2.43	
ON SES COEFFICIENT			
Intercept	11.05**	12.39**	14.39**
Student/teacher ratio	-1.74	-1.31	-1.98
School size (number of students)	-0.15	0.75	-0.91
Classroom organization:			
Team-taught classes	0.60	-0.73	
Departmental structure	-0.19		
Self-contained classrooms		0.63	

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[1] All between-school independent variables have been standardized. See technical notes for more information.

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

The gender equation in this model showed that the average gender gap of 2.6 points in grade eleven math achievement was still present within the different levels of math tracking, the student/teacher ratio, and school size. In addition, the equation showed that in larger schools, girls averaged an additional 2.1 points worse than boys. However, none of the variance in the gender gap was explained by this model (table 8). Thus, there may be other, unmeasured variables that are more associated with the gender gap than those in this model. School structure characteristics were not significantly associated with the effects of race-ethnicity or SES within schools, and the low proportion of variance explained did not differ from that of previous models.

Model 4: Academic Standards

Model 4 tested academic standards in the schools—the rigor of the academic standards, how much these standards had changed, how much homework was given for this grade, and how much control the teachers had over the academic standards. The results are shown in table 6 for grades three, seven, and eleven.

Grade three. The rigor of the academic standards, how much these standards had changed, how much homework was given for this grade, and how much control the teachers had over the academic standards were not significantly associated with average math achievement in schools, controlling for the student body characteristics and other academic standards variables between schools. The academic standards variables were also not significantly associated with the gender, race-ethnicity, and SES coefficients from the within-school equation. Likewise, this model did not increase the proportion of variance explained in these four equations from that of previous models (table 8).

Grade seven. In grade seven, two of the academic standards variables were associated with average math achievement in a school, controlling for the student body characteristics. Schools that had a higher than average change in academic standards averaged 2 points lower in grade seven math achievement, while schools that assigned higher than average amounts of homework averaged 2 points higher in grade seven math achievement. This model raised the proportion of variance in average achievement explained to 72 percent (table 8). However, the academic standards variables were not significantly associated with the effects of gender, race-ethnicity, or SES on mathematics achievement within schools, and the proportions of variance explained in these effects remained similar to those of previous models.

Grade eleven. In grade eleven, of all the academic standards characteristics, only the amount of homework was significantly associated with average math achievement in a school, controlling for the student body characteristics and the other academic standards characteristics between schools. Schools in which higher than the average homework was assigned had higher average math achievement scores by 4 points. However, the proportion of variance in average achievement explained by the model did not rise but dropped slightly to 58 percent (table 8).

The academic standards characteristics were not significantly associated with the effects of gender, race-ethnicity, and SES on achievement within schools. Despite the lack of evidence of association between these characteristics and the effect of race-ethnicity, the proportion of variance in this effect explained by this model rose to 15 percent from 3 percent in Model 1 (table 8). This may indicate that as a group, the academic standards characteristics were slightly associated with the effect of race-ethnicity, even though no individual variables were significant. However, for the effect of SES, the proportion explained remained low (8 percent). Controlling for the student body characteristics and the academic standards characteristics did not reduce the gender gap in grade eleven math achievement. The average gender difference of 2.6 points in grade eleven math achievement was still present within the different levels of rigor and change in academic standards, amount of homework, and teacher control over standards, as well as within all levels of percent black, percent Hispanic, and disadvantaged in the student body. In addition, the proportion of variance in the effects of gender explained by these variables remained at zero (table 8).

Table 6.--Effects of school academic standards on predictors of math achievement, controlling for percent black, percent Hispanic, and disadvantaged level, grades 3, 7, and 11

Effect[1]	Grade 3	Grade 7	Grade 11
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	209.33**	262.05**	298.78**
Rigor of academic standards	-0.39	-0.83	
Change in academic standards		-1.91*	
Amount of homework	1.21	1.86**	4.14**
Teacher control over standards	0.63	-0.04	0.17
ON GENDER COEFFICIENT			
Intercept	-1.42	1.12	-2.58**
Rigor of academic standards	0.07		
Amount of homework	-1.14	1.07	-1.34
Teacher control over standards	-1.05	0.73	1.60
ON RACE-ETHNICITY COEFFICIENT			
Intercept	-14.75**	-15.27**	-18.29**
Rigor of academic standards	1.02		-0.94
Change in academic standards	-2.29		2.57
Amount of homework	-0.86	-0.98	-1.53
Teacher control over standards	0.29	0.73	-2.36
ON SES COEFFICIENT			
Intercept	10.75**	12.48**	14.41**
Rigor of academic standards	1.31	0.04	-0.56
Change in academic standards		-0.79	0.16
Amount of homework	-1.15	0.02	-0.80
Teacher control over standards	0.55	-0.30	0.35

[1] All between-school independent variables have been standardized. See technical notes for more information.

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

Model 5: Principal and Teacher Characteristics

Model 5 tested principal and teacher characteristics in the schools—the number of years the principal had been principal in that school, had been in educational administration, and had taught, the amount of principal time on academic tasks, the amount of principal time meeting with parents or community members, the percentage of teachers who were minority group members, the amount of teacher time on academic tasks for grade seven and eleven teachers, and the amount of teacher/parent interaction. The results are shown in table 7 for grades three, seven, and eleven.

Grade three. The new variables for this model were not significant; that is, none of the principal or teacher characteristics were significantly associated with average math achievement in schools, controlling for the student body characteristics. These variables were also not significantly associated with the gender, race-ethnicity, or SES coefficients from the within-school equation. The proportion of variance explained by this model remained unchanged from previous models for the four equations (table 8).

Grade seven. Grade seven yielded similar results as grade three in that no principal and teacher characteristic variables were significantly associated with average achievement in a school or with the effects of gender, race-ethnicity, or SES on achievement within schools. The proportion of variance explained also remained the same as for previous models (table 8).

Grade eleven. In grade eleven, again no principal or teacher characteristics were significantly associated with average math achievement in schools, and the proportion of variance explained by this model remained the same as for Model 1. With one exception, no principal or teacher characteristics were significantly associated with the effects of gender, race-ethnicity, or SES on math achievement within schools. The exception was in the race-ethnicity equation, where the gap between the group of blacks, Hispanics, and American Indians and the group of whites and Asians was larger by about 3.9 points in schools where the teachers spent a higher amount of their time on academic tasks.[20] Consequently, the proportion of variance in the effects of race-ethnicity explained by this model rose to 30 percent from 3 percent in Model 1 (table 8).

Controlling for principal and teacher characteristics did not explain the gap between boys and girls in math achievement in grade eleven. Girls still averaged 2.9 points less than boys in math achievement. In addition, the proportion of variance in the effect of gender explained by this model remained at zero (table 8).

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[20] This result is surprising and may not be reliable for several reasons. First, the relatively low reliability of the teacher academic time scale in grade eleven indicates that this variable might not actually represent the amount of time a teacher spent on academic tasks for this grade. See technical notes. Second, there may be other, unmeasured variables that could explain and account for this result.

Table 7.--Effects of principal/teacher characteristics on predictors of math achievement, controlling for percent black, percent Hispanic, and disadvantaged level, grades 3, 7, and 11

Effect[1]	Grade 3	Grade 7	Grade 11
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	209.42**	261.47**	298.81**
Principal years as principal	0.57		
Principal years in educational administration	0.13		
Principal years teaching	0.19		
Amount of principal time academic	-0.21		
Amount of principal time with parents	0.49	0.19	1.05
Percent teachers in minority groups	0.88	-1.16	-1.70
Amount of teacher time academic		-0.97	0.22
Amount of parent/teacher time		0.65	-0.94
ON GENDER COEFFICIENT			
Intercept	-1.22	1.08	-2.87**
Principal years as principal	0.08		
Principal years in educational administration	-0.14		
Principal years teaching		0.78	1.13
Amount of principal time with parents	-0.30	-0.20	0.17
Percent teachers in minority groups	-1.17	-0.89	-0.16
Amount of teacher time academic		1.28	-1.27
Amount of parent/teacher time		-0.77	1.25
ON RACE-ETHNICITY COEFFICIENT			
Intercept	-14.89**	-14.98**	-19.54**
Principal years as principal	-0.22		
Principal years in educational administration	-0.78		
Principal years teaching		-0.04	1.52
Amount of principal time with parents	-0.35	0.31	-2.31
Percent teachers in minority groups	-0.72	-1.78	0.04
Amount of teacher time academic		1.20	-3.95*
Amount of parent/teacher time		-1.35	-2.11
ON SES COEFFICIENT			
Intercept	10.98**	12.38**	14.24**
Principal years as principal	0.22		
Principal years in educational administration	-0.16		
Amount of principal time with parents	-0.42	-0.23	-0.38
Percent teachers in minority groups	-0.12	-1.50	-0.75
Amount of teacher time academic		0.79	0.70
Amount of parent/teacher time		-0.58	-0.52

[1] All between-school independent variables have been standardized. See technical notes for more information.

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

C. Summary

There were differences between grades three, seven, and eleven in how well gender, race-ethnicity, and SES predicted math achievement within schools, and in how well the groups of school characteristics predicted between-school variations in average math achievement and the effects of gender, race-ethnicity, and SES.

Effects of Gender, Race-ethnicity, and SES Within Schools

The association of gender, race-ethnicity, and SES with achievement within schools varied between schools, and their average association was summarized across schools. The average predictive effect of gender on math achievement within schools varied between the three grades. In grade three and grade seven, on average across schools there was no evidence of association between gender and math achievement. However, in grade eleven, on average across schools, girls were doing worse than boys in math achievement, with a 2.8 point gap.

Race-ethnicity and SES were significantly associated with math achievement in all three grades, with larger effects in each progressive grade. In grade three, on average across schools, black, Hispanic, and American Indian students were doing worse than white and Asian students, with a 14.6 point gap. In grade seven, the gap was worse at 16.1, and in grade eleven, the gap was up to 19.3 points. For SES in grade three, SES had a differentiating effect of 10.95 points higher or lower achievement, for every standard deviation of SES the students were higher or lower than average SES. In grade seven, this effect was 12.8 points, and in grade eleven, this effect was 14.3 points.

These within-school results show that in math achievement, students were more differentiated by gender, race-ethnicity, and SES in eleventh grade than in grades seven and three. Race-ethnicity and SES differences were present as early as grade three, while gender differences were not present until grade eleven.

Effects of School Characteristics Between Schools

The association of the groups of school characteristics with average math achievement and with the effects of gender, race-ethnicity, and SES also differed by grade. The student body characteristics of percent black, percent Hispanic, and the level of disadvantaged were all negatively associated with the average math achievement in schools in every grade. The higher the percentage of blacks or Hispanics in a school or the more disadvantaged the student body, the lower the average math achievement in schools. However, while the association between percent Hispanic and achievement was similar in each grade, percent black predicted a larger drop in achievement in seventh grade than in grades three or eleven. A higher disadvantaged level predicted a larger drop in achievement in grade three than in grades seven or eleven. In grade seven and in grade eleven it predicted only a small drop in average math achievement, so the effect of attending a school with more disadvantaged students was primarily a factor in the earlier grade.[21]

The student body characteristics were not significantly associated with the effects of race-ethnicity on achievement within schools. However, there were a few associations with the effects of gender and SES. In grade three, girls in schools with higher percentages of blacks had higher average math achievement scores than boys. However, the student body characteristics were not significantly associated with variations in the gender gap in grade seven or eleven. SES was not associated with any student body variables in grade three. However, in grade seven, SES made less of a difference in schools with higher percentages of blacks and Hispanics, and in grade eleven, SES made less of a difference in schools with higher percentages of Hispanics.

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[21] A possible explanation for this result is proposed in the discussion chapter.

Fiscal or physical characteristics did not appear to be significantly associated with average math achievement in grade three. However, one characteristic predicted achievement in grade seven and two characteristics predicted achievement in grade eleven. In both grade seven and grade eleven, schools with higher than average funds per student averaged slightly higher achievement levels. In addition, in grade eleven, schools with specialized science laboratories had higher average math achievement than schools without those laboratories. There was no evidence of an association between fiscal and physical characteristics and the effects of gender, race-ethnicity, or SES in grades three, seven, or eleven.

The classroom, teacher, and student structure characteristics of the schools were significantly associated with average math achievement for three variables in grade three, one variable in grade seven, and two variables in grade eleven. In grade three, larger schools averaged slightly higher achievement. In addition, schools in which grade three was either team-taught or organized in departments averaged slightly higher achievement. In grade seven, only schools with math tracking in seventh grade averaged slightly higher math achievement than other schools. In grade eleven, schools with science tracking in eleventh grade averaged slightly higher math achievement than schools with no science tracking. In addition, like grade three, larger schools averaged higher math achievement. There was no evidence of association between the classroom, teacher, and student structure characteristics of the schools and the effects of gender, race-ethnicity, and SES on math achievement within schools in grades three or seven. However, in grade eleven, in larger schools girls averaged an additional 2 points lower than boys in math achievement, in addition to the 2.6 points below boys they already averaged.

The academic standards in schools were not significantly associated with average math achievement in grade three. However, in grade seven, math achievement was associated with a change in academic standards and with the amount of homework given. In grade seven, schools that experienced more than average changes in academic standards averaged slightly lower math achievement. Also in grade seven, schools with higher than average amounts of homework had slightly higher average levels of math achievement. Similarly, in grade eleven, schools with higher than average amounts of homework had even higher average levels of math achievement. However, there was no evidence of an association between the academic standards in schools and the effects of gender, race-ethnicity, and SES on math achievement in grades three, seven, or eleven.

The principal and teacher characteristics in the schools were not significantly associated with average math achievement or the effects of gender, race-ethnicity, and SES on math achievement in grade three or seven. In grade eleven, one principal and teacher characteristic was associated with the effects of race-ethnicity. In schools where teachers spent higher than average amounts of time on academic tasks, the gap between minorities and whites and Asians was wider.

Proportion of Variance Explained

Table 8 shows the proportion of parameter variance that was explained by each model for each of the four parameters in the three grades for math achievement. The proportion of parameter variance, or R^{2*}, that was explained by most models was, for the most part, quite low. For the parameters of gender, race-ethnicity, and SES, the R^{2*} rarely rose above .15. There were some exceptions. In grade seven, about one-third of the variance in the SES parameter was explained by each model. In grade eleven, 30 percent of the variance in the race-ethnicity parameter was explained by the principal and teacher characteristics model. Otherwise, the models did best at explaining the parameter variance in the intercept parameter, or average math achievement within schools. In these equations, the R^{2*} averaged .60, and was always above .50. None of the models in any of the grades did particularly better than the others. In general, the R^{2*}'s were higher in grades three and seven than in grade eleven.

Table 8.--Proportion of parameter variance explained by each model for math achievement, grades 3, 7, and 11

Parameter	Models 1 Student Body	 2 Fiscal/ Physical	 3 School Structure	 4 Academic Standards	 5 Principal Teacher
Grade 3 Math					
INTERCEPT	0.67	0.67	0.69	0.67	0.66
GENDER COEFFICIENT	0.12	0.14	0.14	0.13	0.11
RACE-ETHNICITY COEFF.	0.09	0.11	0.10	0.12	0.10
SES COEFFICIENT	0.04	0.06	0.08	0.04	0.02
Grade 7 Math					
INTERCEPT	0.68	0.69	0.70	0.72	0.68
GENDER COEFFICIENT	0.07	0.07	0.09	0.09	0.10
RACE-ETHNICITY COEFF.	0.00	0.00	0.00	0.00	0.00
SES COEFFICIENT	0.34	0.34	0.37	0.34	0.36
Grade 11 Math					
INTERCEPT	0.53	0.60	0.60	0.58	0.54
GENDER COEFFICIENT	0.00	0.00	0.00	0.00	0.00
RACE-ETHNICITY COEFF.	0.03	0.07	0.03	0.15	0.30
SES COEFFICIENT	0.09	0.09	0.12	0.08	0.10

NOTE: These are the averages of the proportions from each of the five scores. Negative proportions due to sampling variation have been set to zero.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

These results mean that the variables chosen did better at predicting average math achievement than predicting the effects of gender, race-ethnicity, and SES on math achievement. The significant variables in the equations on the gender, race-ethnicity, and SES parameters certainly reflect associations with those parameters. However, there are probably other, unknown variables that would provide a better explanation of the variance of these parameters and, in the process, might make the current significant variables nonsignificant.

However, for average math achievement and, to a lesser extent, for the effects of SES on math achievement in grade seven and the effects of race-ethnicity on math achievement in grade eleven with the principal and teacher characteristics model, substantial proportions of parameter variance were explained. Therefore, the significant variables in these models may be major explanatory variables of variations between schools in average math achievement in all grades, in the effect of SES on math achievement in grade seven for all models, and in the effect of race-ethnicity on math achievement in grade eleven for the principal and teacher characteristics model.

III. School Effects on Science Achievement

A. Within-School Models

Within each school a regression equation was computed predicting students' science achievement by the student's gender, race-ethnicity, and SES. The averages of these within-school equations for grades three, seven, and eleven science achievement are shown in table 9. For example, under grade three, the average intercept among all the grade three schools is a science achievement score of 207.07. This is the average achievement in the schools. The average coefficient for gender among these schools is -.51, and is not significantly different from zero. Therefore, on average across third grade schools, girls do not do better or worse in science than boys in science, if one controls for race-ethnicity and SES. The average coefficient for race-ethnicity among these schools is -17.89, and is significantly different from zero. This means that, on average across schools, there is a 17.89 point gap in science achievement between the group of blacks, Hispanics, and American Indians and the group of whites and Asians, with the former group doing less well, controlling for gender and SES. The average coefficient for SES among these schools is 14.14, and is significantly different from zero. Since SES has a mean of zero and a standard deviation of one, on average across schools, students one standard deviation above average SES levels are expected to score 14.14 points higher in science achievement than student of average SES. In a similar fashion, students one and one-half standard deviations below average SES are expected to score 21.21 points lower (1.5*14.14) than students of average SES.

Table 9.--Average within-school predictors of science achievement, grades 3, 7, and 11

Predictor	Grade 3	Grade 7	Grade 11
INTERCEPT (AVG. ACHIEVEMENT)	207.07**	242.11**	283.20**
GENDER COEFFICIENT	-0.51	-6.24**	-13.89**
RACE-ETHNICITY COEFFICIENT	-17.89**	-22.32**	-29.49**
SES COEFFICIENT	14.14**	18.33**	20.92**

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

These equations indicate that on average for each grade, students who were minority did less well in science achievement than non-minorities, controlling for gender and SES. This gap between the minorities and the others was wider in grade seven than grade three, and wider in grade eleven than grade seven. Likewise, in all three grades, SES had a differentiating effect in that students of higher SES did better in science than students of lower SES, controlling for race-ethnicity and gender. This effect of SES also was stronger in the higher grades than in the lower grades. On average across schools, gender was not associated with student science achievement in grade three. However, in grade seven, girls did less well in science than boys by an average of about 6 points, controlling for race-ethnicity and SES. And in grade eleven, the gap between boys and girls was almost three times as large—girls did less well in science than boys by an average of about 14 points, controlling for race-ethnicity and SES.

These equations represent the average level of science achievement in the schools and the average relationship within schools between gender, race-ethnicity, and SES and science achievement. However, as with math achievement, these relationships and the level of average science achievement actually varied quite a bit between schools. The purpose of the between-school models was to explain this variation. What characteristics in schools were associated with higher or lower average science achievement in a school? What school characteristics were associated with stronger or weaker effects of gender, race-ethnicity, or SES on science achievement? In Models 1-5, each of the coefficients and the intercept became a dependent variable in a between-school regression equation that predicted their value based on school-level characteristics.

B. Between-School Models

The between-school models tested groups of school-level variables in four regression equations whose dependent variables were the intercepts and the coefficients on gender, race-ethnicity, and SES from the within-school equations. Each model tested the same group of variables used in the analysis of mathematics achievement presented above. Model 1 tested variables related to the student body composition of the schools. Model 2 tested fiscal and physical characteristics of the schools. Model 3 tested variables related to the school program structure of student, teacher, and classroom organization in the schools. Model 4 tested academic standards in the schools. Model 5 tested principal and teacher characteristics in the schools. The results of each of these science achievement analyses are presented below for each grade. A summary of the findings from all of these analyses follows this presentation. This summary includes a discussion of the proportion of parameter variance explained by each model. These proportions are shown in table 15.

Model 1: Student Body Characteristics

Model 1 tested variables related to the student body composition in the schools—the percentage of the students who were minority in each school, and how disadvantaged were the students in each school as a whole. These variables were tested to see if they could explain the variation in the within-school equation intercept and coefficients that predicted science achievement. The results are shown in table 10 for grades three, seven, and eleven.

Grade three. The results presented in table 10 indicate that for every standard deviation above the average percentage of blacks in a school, average science achievement in that school was 11.1 points lower, for every standard deviation above the average of percentage of Hispanics in a school, average science achievement in that school was 6.09 points lower, and for every standard deviation above the average level of disadvantaged of a school, average science achievement in that school was 10.24 points lower, with these three variables controlling for each other. As shown in table 15, 71 percent of the variance in average science achievement were explained by this model.

In the next equation, the gender coefficient from the within-school equation was not significantly associated with percent black, percent Hispanic, or the level of disadvantaged in a school. Controlling for these variables in schools, gender continued to have no association with average science achievement, as shown by a non-significant intercept. Not surprisingly, these student body variables explained only 8 percent of the variance in the gender gap in science achievement (table 15).

In the race-ethnicity equation, the race-ethnicity coefficient from the within-school equation was not significantly associated with percent black, percent Hispanic, or the disadvantaged level in a school, controlling for each other. Instead, the minority gap in science achievement remained at 18.11 points, controlling for these student body characteristics, as shown by a significant intercept. Only 3 percent of the variance in the minority gap was explained by this model (table 15).

In the SES equation, the SES coefficient from the within-school equation also was not significantly associated with percent black, percent Hispanic, or disadvantaged level in a school, controlling for each other. As shown by the significant intercept, the differentiating effect of SES in science achievement remained at 14.31 points for every standard deviation of SES above or below the average of SES. Nevertheless, this model explained 14 percent of the variance in the effect of SES on achievement (table 15).

Table 10.--Effects of student body characteristics on predictors of science achievement, grades 3, 7, and 11

Effect[1]	Grade 3	Grade 7	Grade 11
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.08**	240.07**	284.60**
Percent black	-11.10**	-16.87**	-13.08**
Percent Hispanic	-6.09**	-9.16**	-7.54**
Disadvantaged level	-10.24**	-2.36**	-3.05**
ON GENDER COEFFICIENT			
Intercept	-0.74	-6.21**	-13.90**
Percent black	0.93	-1.21	0.67
Percent Hispanic	-0.66	-0.19	0.54
Disadvantaged level	2.33	0.11	0.04
ON RACE-ETHNICITY COEFFICIENT			
Intercept	-18.11**	-22.21**	-29.88**
Percent black	-1.14	0.42	-2.47
Percent Hispanic	1.22	0.88	2.86
Disadvantaged level	2.00	-0.04	2.34
ON SES COEFFICIENT			
Intercept	14.31**	17.91**	21.36**
Percent black	-0.92	-3.96**	-2.80*
Percent Hispanic	-1.25	-3.22**	-3.61**
Disadvantaged level	-3.64	-1.05	-1.07

[1] All between-school independent variables have been standardized. See technical notes for more information.

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

In summary for grade three science achievement, these student body characteristics appear to be significantly associated with average achievement in a school. However, there was no evidence of associations between the student body characteristics and the effects of gender, race-ethnicity, or SES on achievement within schools.

Grade seven. In grade seven, all of the student body characteristics were significantly associated with average science achievement in a school. Percent black and percent Hispanic both predicted a slightly larger drop in achievement levels than in grade three. However, while the disadvantaged level of a school was associated with average achievement, schools with higher than average disadvantaged levels averaged science achievement only 2 points lower—a much smaller effect than the 10 points lower in grade three. This model did well in explaining the variance in average science achievement—80 percent of the variance was explained (table 15).

There was no evidence of association between the student body characteristics and the effects of gender or race-ethnicity on achievement within schools. Nor was any variance in these effects explained by this model. However, higher percentages of black and Hispanic students were associated with a lower effect of SES on science achievement in grade seven within schools. As with math achievement, this result could be due to a more limited range of SES levels in these schools. However, it is puzzling that higher disadvantaged levels were not associated with lower effects of SES as well. Nevertheless, almost half of the variance in the effect of SES was explained by this model (table 15).

Grade eleven. In grade eleven, all the student body characteristics were associated with average science achievement in a school, and two of those characteristics were significantly associated with the effect of SES. The negative effect of percent black on average science achievement was not as large as it was in grade seven and was closer to its effect in grade three. The negative effect of percent Hispanic on average science achievement was similar in size to the effect in grade three and grade seven. The disadvantaged level in the school was negatively associated with science achievement, but as in grade seven, the effect was much smaller than in grade three. This model explained about two-thirds of the variance in science achievement (table 15).

In grade eleven, the gender gap, the minority gap, and the differentiating effect of SES remained the same as they were before they were controlled for the student body characteristics. There was no evidence of association between these characteristics and the effects of gender or race-ethnicity. In addition, although 12 percent of the variance in the effect of race-ethnicity was explained by this model, only 1 percent of the effect of gender was accounted for (table 15).

The differentiating effect of SES on science achievement within schools in grade eleven was associated with percent black and percent Hispanic. In schools with higher percentages of black and/or Hispanic students, SES had less of a differentiating effect. However, this effect was not significantly associated with the disadvantaged level of a school. While schools with higher black and Hispanic populations may have a more limited range of SES levels than other schools, it is puzzling that more disadvantaged schools did not have lower SES effects as well. One-quarter of the variance in the effect of SES was explained by this model (table 15).

Models 2-5

Models 2 through 5 tested various groups of variables to see if they could explain the variation in the within-school equation intercept and coefficients that predicted science achievement. Included in each of these models as controls were the student body characteristic variables of percent black, percent Hispanic, and disadvantaged level of a school. Their effects remained similar in each model, and they are not reported here in order to focus attention on the new variables in Models 2 through 5.

Model 2: Fiscal and Physical Characteristics

Model 2 tested variables related to the fiscal and physical characteristics of schools—the instructional funds spent per student, the number of microcomputers per student, and whether or not a school had classroom science labs, general science labs, and specialized science labs. The results are shown in table 11 for grades three, seven, and eleven.

Table 11.--Effects of fiscal/physical school characteristics on predictors of science achievement, controlling for percent black, percent Hispanic, and disadvantaged level, grades 3, 7, and 11

Effect[1]	Grade 3	Grade 7	Grade 11
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.05**	240.36**	285.23**
Instructional funds/student	-1.00	0.65	0.96
Microcomputers/student	1.29	-0.11	-0.69
Have general science lab	1.09	0.69	-3.00**
Have specialized science lab	0.18	0.64	5.12**
ON GENDER COEFFICIENT			
Intercept	-0.50	-5.01**	-13.93**
Instructional funds/student	-1.90	0.80	-0.71
Microcomputers/student	0.94	0.07	-1.02
Have specialized science lab	-0.52	-0.29	-0.58
ON RACE-ETHNICITY COEFFICIENT			
Intercept	-17.93**	-22.74**	-30.10**
Instructional funds/student	0.13	-0.11	1.48
Microcomputers/student	-0.26	-0.90	-2.19
Have specialized science lab	-1.89	-0.08	-0.76
ON SES COEFFICIENT			
Intercept	14.60**	17.89**	20.67**
Instructional funds/student	1.05	0.20	-0.81
Microcomputers/student	-0.11	0.69	0.72
Have specialized science lab	-1.73	0.48	2.32

[1] All between-school independent variables have been standardized. See technical notes for more information.

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

Grade three. For grade three science achievement, the fiscal and physical school characteristic variables do not appear to have an association with average achievement in a school, nor with the effects of gender, race-ethnicity, or SES on achievement within schools. In this model, instructional funds per student, computers per student, having a general science lab and having a specialized science lab were not significantly associated with average science achievement in a school after controlling for student body characteristics. In addition, the proportion of variance in achievement explained by this model was close to the 72 percent explained by Model 1, which included only student body characteristics (table 15).

Controlling for the student body characteristics, variations in the gender, race-ethnicity, and SES coefficients from the within-school equation were also not significantly associated with instructional funds per student, computers per student, or having a specialized science lab. The proportions of variance in these coefficients explained by this model were also similar to the low proportions explained by Model 1 (table 15).

Grade seven. Grade seven yielded similar results in that the fiscal and physical school characteristics did not appear to have any association with average achievement in a school, nor with the effects of gender, race-ethnicity, or SES on achievement within schools. In addition, the proportion of variance explained in each equation by this model was the same as that explained by Model 1 (table 15).

Grade eleven. In grade eleven, two fiscal or physical school characteristics had associations with average science achievement, but none of the characteristics appeared to be significantly associated with the effects of gender, race-ethnicity, or SES on science achievement within schools. Schools with general science labs had average science achievement scores of 3 points lower than schools without them, while schools with specialized science labs had average science achievement scores of 5.1 points higher than schools without them, controlling for the student body characteristics and the other fiscal and physical characteristics. Consequently, the proportion of variance explained in average science achievement rose from 65 to 70 percent between Model 1 and this model (table 15). However, there was no change in the proportion of variance explained by this model in the effects of gender, race-ethnicity, and SES.

Model 3: School Structure of Student, Teacher, and Classroom Organization

Model 3 tested variables related to the structure of student, teacher, and classroom organization in the schools—the student/teacher ratio, the school size in number of students, and whether the classrooms in this grade were organized as self-contained classes, team-taught, or organized as departments. The classroom organization variable consisted of a group of dummy variables indicating whether classrooms were self-contained, team-taught, or organized departmentally. Since most of grade three classrooms were self-contained, that was the reference category for that grade. For grades seven and eleven, the reference category was departmental, since most were organized in that way. In addition, two additional variables were tested for grades seven and eleven—whether there was math tracking in that grade, and whether there was science tracking in that grade. The results are shown in table 12 for grades three, seven, and eleven.

Grade three. For grade three science achievement, all of the new variables for this model—the student/teacher ratio, the school size in number of students, and whether the classrooms in this grade were organized as team-taught or organized as departments—were significantly associated with average science achievement in schools, controlling for the

Table 12.--Effects of school structure characteristics on predictors of science achievement, controlling for percent black, percent Hispanic, and disadvantaged level, grades 3, 7, and 11

Effect[1]	Grade 3	Grade 7	Grade 11
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.05**	240.39**	284.48**
Math tracking		1.65*	
Science tracking			2.12*
Student/teacher ratio	-2.07*	-0.92	0.76
School size (number of students)	2.38*	0.72	3.82
Classroom organization:			
Team-taught classes	2.06*		
Departmental structure	1.68*		
ON GENDER COEFFICIENT			
Intercept	-0.69	-6.15**	-13.70**
Math tracking			
Science tracking			-0.99
Student/teacher ratio	-2.13*	-0.58	0.01
School size (number of students)	1.12	-0.37	-0.41
ON RACE-ETHNICITY COEFFICIENT			
Intercept	-18.02**	-22.3**	-30.60**
Student/teacher ratio	-0.12	0.15	1.23
School size (number of students)	1.34	-0.08	1.82
Classroom organization:			
Team-taught classes	-0.87		
Departmental structure	-0.56		
Self-contained classrooms		1.47	-1.20
ON SES COEFFICIENT			
Intercept	14.76**	17.95**	21.43**
Student/teacher ratio	-1.26	0.28	1.47
School size (number of students)	0.47	-0.23	-0.01
Classroom organization:			
Team-taught classes	0.27		
Departmental structure	-1.65		
Self-contained classrooms		-0.53	0.91

[1] All between-school independent variables have been standardized. See technical notes for more information.

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

student body characteristics. However, the proportion of variance in science achievement explained by this model was no different from that explained by Model 1 (table 15).

The student/teacher ratio was significantly associated in the gender equation with the gender coefficient from the within-school equation. In schools with a higher student/teacher ratio, girls averaged lower than boys in grade three science achievement. However, only 14 percent of the variance in the gender coefficient was explained by these variables (table 15).

The school structure variables were not significantly associated with the race-ethnicity coefficient or with the SES coefficient. In addition, the proportions of variance in these coefficients explained by this model did not differ from the proportions explained by Model 1 (table 15).

Grade seven. In grade seven, none of the school structure variables that had been significant in grade three were significantly associated with average science achievement in schools, controlling for the student body characteristics. However, schools with math tracking in grade seven averaged 1.7 points higher in science achievement than schools without math tracking. There was no evidence of any association between the school structure variables and the effects of gender, race-ethnicity, or SES on achievement within schools. In addition, this model did not explain any more variation in achievement or in the effects of gender, race-ethnicity, or SES than was explained by Model 1 (table 15). There continued to be an average gap between girls and boys and between minorities and whites and Asians, controlling for the school structure and student body characteristics. Furthermore, SES continued to have a large differentiating effect on science achievement, controlling for these characteristics.

Grade eleven. Likewise, in grade eleven, only one school structure characteristic was associated with average science achievement in a school—science tracking. Schools with science tracking in grade eleven averaged 2.1 points higher in science achievement than schools without tracking. This model explained the same proportion of variance in achievement that was explained by Model 2—70 percent (table 15).

None of the school structure characteristics were significantly associated with the effects of gender, race-ethnicity, or SES on science achievement within schools. In addition, no more variance in these effects was explained by this model than was explained by Model 1. There continued to be an average gap between girls and boys and between minorities and whites and Asians, controlling for the student body characteristics and the school structure characteristics. Finally, similar to grade seven, SES continued to have a large differentiating effect on science achievement, controlling for these characteristics.

Model 4: Academic Standards

Model 4 tested academic standards in the schools—the rigor of the academic standards, how much these standards had changed, how much homework was given for this grade, and how much control the teachers had over the academic standards of the school. The results are shown in table 13 for grades three, seven, and eleven.

Grade three. For grade three science achievement, the academic standard variables did not appear to have a strong association with average achievement in a school, or with the effects of gender, race-ethnicity, or SES on achievement within schools. The rigor of the academic standards, how much these standards had changed, and how much homework was given for this grade were not significantly associated with average science achievement in schools, controlling for the student body characteristics and other academic standards variables between schools. In addition, the same proportion of variance in achievement was explained by this model as was explained by Model 1—71 percent (table 15).

There was also no evidence of an association between the academic standards variables and the gender, race-ethnicity, and SES coefficients from the within-school equation. The intercept of the gender equation, controlling for percent black, percent Hispanic, the disadvantaged level of the school, the rigor of the academic standards, how much these standards had changed, and how much homework was given for this grade, showed that gender still did not have a significant association with achievement. The intercept of the race-ethnicity equation, controlling for the same variables, continued to predict that there was a 18.1 point gap in science achievement between the group of blacks, Hispanics, and American Indians and the group of whites and Asians, with the former group achieving significantly less than the latter, but there were no significant variables to explain variations in that gap. Likewise the intercept of the SES equation, controlling for the same variables, continued to predict that those with higher SES would do better and those with lower SES would do worse, but there were again no significant variables to explain variations in that relationship. This model explained no more variance in these effects than the little explained by Model 1 (table 15).

Table 13.--Effects of school academic standards on predictors of science achievement, controlling for percent black, percent Hispanic, and disadvantaged level, grades 3, 7, and 11

Effect[1]	Grade 3	Grade 7	Grade 11
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.48**	241.04**	284.95**
Rigor of academic standards	-0.57		1.43
Change in academic standards	0.12	-2.36**	-0.22
Amount of homework	0.70	1.12	4.41**
Teacher control of academic standards		0.75	1.06
ON GENDER COEFFICIENT			
Intercept	-0.84	-5.97**	-13.91**
Rigor of academic standards	0.90		
Change in academic standards	1.16		
Amount of homework	-1.78	1.55	0.25
Teacher control of academic standards		0.22	0.22
ON RACE-ETHNICITY COEFFICIENT			
Intercept	-18.07**	-22.42**	-29.84**
Rigor of academic standards	0.30		
Change in academic standards	-1.66		
Amount of homework	1.10	-1.16	-2.11
Teacher control of academic standards		0.49	-0.84
ON SES COEFFICIENT			
Intercept	14.39**	17.94**	21.03**
Rigor of academic standards	0.18	1.45	0.41
Change in academic standards		-1.30	-0.53
Amount of homework	1.00	-0.90	1.30
Teacher control of academic standards		1.22	0.18

[1] All between-school independent variables have been standardized. See technical notes for more information.

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

Grade seven. In grade seven, one of the academic standards variables was associated with average achievement in a school. Schools with higher than average amounts of changes that increased academic standards averaged science achievement scores that were 2.4 points lower in grade seven, controlling for the student body characteristics and the other academic standards characteristics between schools. The variance in achievement explained by this model rose slightly from 80 percent in Model 1 to a high of 82 percent (table 15).

As in grade three, none of the academic standards variables was significantly associated with the effects of gender, race-ethnicity, or SES on achievement within schools. This model explained none of the variance in the effects of gender or race-ethnicity, and added nothing to the proportion of variance in the effect of SES (48 percent) explained by Model 1(table 15). Controlling for the academic standards and student body characteristic variables, there continued to be a gender gap in science achievement of about 6 points, a minority gap of about 22 points, and a large differentiating effect of SES of about 18 points for every standard deviation above or below average SES.

Grade eleven. In grade eleven, of all the academic standards characteristics, only the amount of homework was significantly associated with average science achievement in a school, controlling for the student body characteristics and the other academic standards characteristics between schools. Schools with higher than the average amounts of homework given in grade eleven had higher average science achievement scores by 4.4 points. As shown in table 15, the proportion of variance in achievement explained by this model (69 percent) was slightly higher than that explained by Model 1 (65 percent). None of the academic standards characteristics were significantly associated with the effects of gender, race-ethnicity, or SES on science achievement within schools. In addition, this model explained the same proportions of variance in these effects as explained by Model 1. Controlling for these variables, there continued to be a gender gap in science achievement of 14 points, a minority gap of 30 points, and a large differentiating effect of SES of 21 points for every standard deviation above or below average SES.

Model 5: Principal and Teacher Characteristics

Model 5 tested principal and teacher characteristics in the schools—the number of years the principal had been principal in that school, had been in educational administration, and had taught, the amount of principal time on academic tasks, the amount of principal time meeting with parents or community members, the percentage of teachers who were minority group members, the amount of teacher time on academic tasks for grade seven and eleven teachers, and the amount of teacher/parent interaction. The results are shown in table 14 for grades three, seven, and eleven.

Table 14.--Effects of principal/teacher characteristics on predictors of science achievement, controlling for percent black, percent Hispanic, and disadvantaged level, grades 3, 7, and 11

Effect[1]	Grade 3	Grade 7	Grade 11
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.06**	240.02**	284.45**
Principal years as principal	0.63		
Principal years in educational administration	-0.40		
Principal years teaching	0.08		
Amount of principal time academic	0.48		
Amount of principal time with parents	0.47	-0.07	
Percent teachers in minority groups	0.03	-0.83	-1.29
Amount of teacher time academic		-0.53	-0.48
Amount of parent/teacher time		0.40	-0.76
ON GENDER COEFFICIENT			
Intercept	-0.87	-6.19**	-14.07**
Principal years as principal	1.01		
Principal years in educational administration	-1.56		
Principal years teaching		1.08	0.00
Amount of principal time with parents	-0.69	1.28	0.39
Percent teachers in minority groups	-0.47	-1.15	-0.52
Amount of teacher time academic		1.29	-0.45
Amount of parent/teacher time		-2.18**	0.03
ON RACE-ETHNICITY COEFFICIENT			
Intercept	-18.09**	-21.91**	-30.27**
Principal years as principal	-0.57	2.57	
Principal years in educational administration	0.90	0.22	2.10
Principal years teaching		-0.96	0.77
Amount of principal time academic		-0.41	
Amount of principal time with parents	1.15		-1.26
Percent teachers in minority groups	0.33		-2.21
Amount of teacher time academic			-0.01
Amount of parent/teacher time			-2.30
ON SES COEFFICIENT			
Intercept	14.42**	17.89**	21.40**
Principal years as principal	0.22	-0.30	
Principal years in educational administration	0.88	0.49	
Principal years teaching		0.32	
Amount of principal time with parents	-0.39		-0.48
Amount of principal time academic		0.02	-0.33
Percent teachers in minority groups	-0.50		
Amount of teacher time academic			2.17
Amount of parent/teacher time			-0.92

[1] All between-school independent variables have been standardized. See technical notes for more information.

NOTE: ** probability ≤ .01; * probability ≤ .05

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

Grade three. For grade three science achievement, the principal and teacher characteristics did not appear to have an association with average achievement in a school, nor with the effects of gender, race-ethnicity, or SES on achievement within schools. There was no evidence of a significant association between the principal or teacher characteristics and average science achievement in schools, controlling for the student body characteristics and the other academic standards characteristics between schools. The proportion of variance in achievement explained by this model was no different than that explained by Model 1 (table 15).

These variables were also not significantly associated in the gender equation with the gender coefficient from the within-school equation, in the race-ethnicity equation with the race-ethnicity coefficient from the within-school equation, or in the SES equation with the SES coefficient from the within-school equation. Similarly, the proportion of variance in these effects was the same as explained by Model 1 (table 15). Controlling for the student body and teacher and principal characteristic variables, there was still no gender gap in science achievement, a minority gap of about 18 points, and a differentiating effect of SES of about 14 points for every standard deviation above or below average SES.

Grade seven. Grade seven yielded similar results as grade three. There was no evidence of any significant associations between the principal and teacher characteristic variables and average achievement in a school, controlling for the student body characteristics and the other principal and teacher characteristics between schools. In addition, no principal or teacher characteristics were significantly associated with the effects of race-ethnicity or SES on achievement within schools. The proportion of variance explained by this model in these three equations was the same as that explained by Model 1 (table 15)

However, one characteristic was associated with the effect of gender. In schools with higher than average parent/teacher interaction, girls averaged 2 more points worse than boys, on top of the existing average gap between girls and boys. Still, no variance in the effect of gender was explained by this model (table 15). Controlling for the student body and teacher and principal characteristic variables, there continued to be a gender gap in science achievement of about 6 points, a minority gap of about 22 points, and a differentiating effect of SES of about 18 points for every standard deviation above or below average SES.

Grade eleven. In grade eleven, there was again no evidence of any associations between the principal or teacher characteristics and average science achievement in schools, or with the effects of gender, race-ethnicity, or SES on science achievement within schools. In addition, no more variance was explained by this model than was explained by Model 1. Controlling for the student body and teacher and principal characteristic variables, there continued to be a gender gap in science achievement of about 14 points, a minority gap of about 30 points, and a differentiating effect of SES of about 21 points for every standard deviation above or below average SES.

C. Summary

There were differences between grades three, seven, and eleven in how well gender, race-ethnicity, and SES predicted science achievement within schools, and in how well the groups of school characteristics predicted between-school variations in average science achievement and the effects of gender, race-ethnicity, and SES.

Effects of Gender, Race-ethnicity, and SES Within Schools

The association of gender, race-ethnicity, and SES with achievement within schools varied between schools, and their average association was summarized across schools. The average predictive effect of gender on science achievement within schools varied between the three grades. In grade three, on average across schools, gender had no association with science achievement. However, in grade seven, on average across schools, girls were doing worse than boys in science achievement, with a 6-point gap. In grade eleven, girls were doing even worse than boys, with a 14-point gap.

Race-ethnicity and SES were significantly associated with science achievement in all three grades, with larger effects in each progressive grade. In grade three, on average across schools, black, Hispanic, and American Indian students were doing worse than white and Asian students, with an 18-point gap. In grade seven, the gap was worse at 22, and in grade eleven, the gap was up to 30 points. For SES in grade three, SES had a differentiating effect of 14 points higher or lower achievement, for every standard deviation of SES the students were higher or lower than average SES. In grade seven, this effect was 18 points, and in grade eleven, this effect was 21 points.

These within-school results show that in science achievement, students were more differentiated by gender, race-ethnicity, and SES in eleventh grade than in grades seven and three. Race-ethnicity and SES differences were present as early as grade three, while gender differences were not present until grade seven.

Effects of School Characteristics Between Schools

The association of the groups of school characteristics with average science achievement and with the effects of gender, race-ethnicity, and SES also differed by grade. The student body characteristics of percent black, percent Hispanic, and the level of disadvantaged were all negatively associated with the average science achievement in schools in every grade. The higher the percent black or percent Hispanic or the more disadvantaged the student body, the lower the average science achievement in schools. However, while the association between percent Hispanic and achievement was similar in each grade, the negative effect of percent black on achievement was stronger in seventh grade than in grades three or eleven. The disadvantaged level predicted much lower achievement in grade three than in grade seven or grade eleven, where it was significant, but had only small effects. Therefore the effect of attending a school with more disadvantaged students was primarily a factor in grade three.[22]

The student body characteristics were not associated with the effects of gender or race-ethnicity on achievement within schools. However, there were a few associations with the effects of SES. In both grade seven and eleven, SES made less of a difference in schools with higher percentages of blacks and/or Hispanics. However, SES was not significantly associated with any student body characteristics in grade three.

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[22] A possible explanation for this result is proposed in the discussion chapter.

The fiscal and physical characteristics did not appear to be associated with average science achievement in grades three or seven. In addition, there was no evidence of associations between the fiscal and physical characteristics and the effects of gender, race-ethnicity, or SES in grades three, seven, or eleven. However, in grade eleven, schools with general science labs had lower average science achievement, and schools with specialized science laboratories had higher average science achievement.

The classroom, teacher, and student structure characteristics of the schools were significantly associated with average science achievement for four variables in grade three, one variable in grade seven, and one variable in grade eleven. In grade three, schools with higher student/teacher ratios averaged slightly lower achievement, while schools that were larger than average, or had team-taught classes or a departmental structure in grade three averaged slightly higher achievement. However in grades seven and eleven, only tracking was associated with achievement. Schools with math tracking in grade seven and science tracking in grade eleven averaged slightly higher achievement in each respective grade than schools without that particular tracking. Only one school structure variable was significantly associated with the effects of gender, race-ethnicity, and SES on science achievement within schools in grades three, seven, or eleven. In grade three, girls averaged slightly lower than boys in science achievement if they were in schools with a higher than average student/teacher ratio.

The academic standards in schools were not significantly associated with average science achievement in grade three. However, in grade seven, schools with higher than average changes in academic standards averaged slightly lower levels of science achievement. In grade eleven, schools with higher than average amounts of homework had higher average levels of science achievement. There was no evidence of association between academic standards and the effects of gender, race-ethnicity, and SES on science achievement in grades three, seven, or eleven.

The principal and teacher characteristics in the schools were not significantly associated with average science achievement or the effects of race-ethnicity or SES on science achievement in grades three, seven, or eleven. These characteristics were also not significantly associated with the effects of gender on science achievement in grades three and eleven. However, one characteristic was significantly associated with the effects of gender on achievement in grade seven. In schools with more parent/teacher interactions, girls averaged slightly lower than boys in grade seven science achievement.

Proportion of Variance Explained

Table 15 shows the proportion of parameter variance that was explained by each model for each of the four parameters in the three grades for science achievement. In grade three, the proportion of parameter variance, or R^{2*}, that was explained by most models was, for the most part, quite low. For the parameters of gender, race-ethnicity, and SES, the R^{2*} never rose above .15. The models did best at explaining the parameter variance in the intercept parameter, or average science achievement within schools. In these equations, the R^{2*} hovered around .72, and none of the models did particularly better than the others.

Table 15.--Proportion of parameter variance explained by each model for science achievement, grades 3, 7, and 11

	Models				
Parameter	1 Student Body	2 Fiscal/ Physical	3 School Structure	4 Academic Standards	5 Principal Teacher
Grade 3 Science					
INTERCEPT	0.71	0.72	0.73	0.71	0.70
GENDER COEFFICIENT	0.08	0.14	0.12	0.09	0.08
RACE-ETHNICITY COEFF.	0.03	0.03	0.03	0.05	0.03
SES COEFFICIENT	0.14	0.15	0.14	0.13	0.13
Grade 7 Science					
INTERCEPT	0.80	0.80	0.81	0.82	0.80
GENDER COEFFICIENT	0.00	0.00	0.00	0.00	0.00
RACE-ETHNICITY COEFF.	0.00	0.00	0.00	0.00	0.00
SES COEFFICIENT	0.46	0.46	0.46	0.48	0.44
Grade 11 Science					
INTERCEPT	0.65	0.70	0.70	0.69	0.65
GENDER COEFFICIENT	0.01	0.01	0.00	0.00	0.00
RACE-ETHNICITY COEFF.	0.12	0.10	0.10	0.12	0.10
SES COEFFICIENT	0.25	0.26	0.24	0.25	0.24

NOTE: These are the averages of the proportions from each of the five scores. Negative proportions due to sampling variation have been set to zero.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

However, in grades seven and eleven, the R^{2*}s had a different pattern. In these grades, while the proportion of parameter variance explained for the parameters of gender and race-ethnicity remained low, these models explained about 46 percent of the variance in the SES slope in grade seven, and about 25 percent of the variance in the SES slope in grade eleven. In addition, the percentage of variance explained in the intercept in grade seven was around 80 percent, while in grade eleven it was about 68 percent. However, again, none of the models did particularly better than the others.

These results mean that in grade three, the variables chosen did better at predicting average science achievement than predicting the effects of gender, race-ethnicity, and SES on achievement. In grades seven and eleven, the variables also did fairly well at predicting the effect of SES on achievement. Otherwise, while some of the variables used in this analysis were able to explain some of the variance among the gender, race-ethnicity, and SES effects, there are probably other, unknown variables that would provide a better explanation of the variance of these parameters.

However, for average science achievement in all grades, and for the effects of SES on science achievement in grades seven and eleven, substantial proportions of parameter variance were explained. Therefore, the significant variables in these models may be the major explanatory variables of variations between schools in average science achievement, and, to a lesser extent, in the effects of SES on science achievement.

D. Comparison of Math and Science Results

The effects of the school characteristics on math and science achievement were similar by subject, although they usually varied by grade. In general, the school characteristics did better at explaining average achievement between schools than explaining the effects of gender, race-ethnicity, and SES on achievement. That is, the proportion of variation explained in average math and science achievement was high for all grades and models, while the proportion of variation explained in the effects of gender, race-ethnicity, and SES was almost always very low, with a few exceptions.

Within schools, the effects of race-ethnicity and SES on math and science achievement were consistent within schools in all three grades studied, while the effects of gender varied. On average within schools, students from minority or low SES backgrounds tended to have lower scores on the NAEP tests, controlling for gender. The average within-school effect of gender on math and science achievement varied by subject and grade. While there were essentially no differences in boys' and girls' math and science achievement in the third grade or in seventh grade math, boys averaged higher scores than girls in science in the seventh grade and in both math and science in the eleventh grade, controlling for race-ethnicity and SES.

Of all the school-level characteristics, the student body characteristics had the most associations with both average achievement and the effects of gender and SES. However, no evidence of association was found between the student body characteristics and the effect of race-ethnicity. In both subjects, the student body characteristics of percent black, percent Hispanic, and disadvantaged level of the students were always associated with lower average achievement. However, in all grades, these three variables were always associated with lower average achievement in science than in math.

There were also variations by grade in the association of student body characteristics with achievement. Being in a school with higher percentages of black students was associated with lower achievement in seventh grade than in third grade or eleventh grade in both subjects, while being in a school with higher percentages of Hispanic students was associated with a similar drop in achievement in all grades. Being in a school with more disadvantaged students was associated with lower average achievement in third grade, but in seventh and eleventh grade, the drop in achievement was significant but negligible.

Two of the student body characteristics were significantly associated with the effects of gender in third grade math and with the effects of SES in seventh and eleventh grade math and science. In schools with higher percentages of black students, girls tended to perform better than boys in third grade math. In grades seven and eleven, SES had less of a differentiating effect on both math and science achievement in schools with higher percentages of black and/or Hispanic students.

Controlling for the student body characteristics, some of the other school characteristics in the other four models were also associated with average achievement—four characteristics in grade three, four in grade seven, and six in grade eleven. In addition, four characteristics were associated with the effects of gender or race-ethnicity—one in grade three, one in grade seven, and two in grade eleven. Characteristics that explained average achievement usually varied by grade, but not often by subject. Within each grade, similar characteristics often explained both math and science achievement. No other school characteristics were found to be significantly associated with the effect of SES, and the few characteristics that were associated with the effects of gender and race-ethnicity varied by grade and subject.

In grade three, for both math and science achievement, larger schools, team-taught classes, and classrooms organized by departments were associated with higher average achievement. In addition, for science achievement only, higher student/teacher ratios were associated with lower average science achievement. Higher student /teacher ratios were also associated with a gender gap between girls and boys in science—girls averaged lower science achievement scores than boys in schools with higher student/teacher ratios.

In grade seven, for both math and science achievement, schools with math tracking were associated with higher average achievement, while schools with higher numbers of positive changes in academic standards were associated with lower average achievement. In addition, for math achievement only, schools with more instructional funds per students and schools that gave higher amounts of homework were associated with higher average math achievement. For science achievement only, schools with more parent/teacher interactions were associated with a larger than average gap between girls and boys in science achievement—girls averaged lower science achievement scores than boys in these schools.

In grade eleven, for both math and science achievement, schools with specialized science labs, with science tracking, and with larger amounts of homework given were associated with higher average achievement. In addition, for math achievement only, schools with more instructional funds per student and larger schools were associated with higher math achievement. However, larger schools were also associated with a larger gender gap in math achievement—girls averaged lower math achievement than boys in larger schools. Another factor associated with math achievement was that in schools where teachers spent proportionally more time on academic tasks, blacks, Hispanics, and Native Americans averaged lower math achievement than whites and Asians. For science achievement only, schools with general science labs were associated with lower average science achievement.

IV. Discussion

From the beginning of research on school performance in the 1950s, focus has been on the schools themselves—their organization, funding levels, and personnel. The assumption in this research was that "schools made a difference" and that better teachers, better facilities, and better leadership would lead to improvement in student achievement.

This assumption was questioned in the mid-1960s with the publication of James Coleman's *Equality of Educational Opportunity*, which argued that academic performance was determined almost entirely by background characteristics of the students themselves and not the characteristics of schools.[23] Coleman's study sparked new interest in the antecedents to educational performance and challenged educational researchers to improve their models of the educational process and the role of schools in educational achievement. At the same time that social scientists were questioning old assumptions about effective schools, standardized test scores of student performance started to decline. These two events led to a torrent of studies on schools and school performance that continues today.

Unfortunately, this line of research has been plagued by methodological problems that have called into question its validity and utility. Many of these problems have been derived from the multilevel nature of the data. That is, students, at one level, are imbedded in schools at another level.[24] In the past, it has been all too easy to confound student-level effects with school-level effects. This report has tried to overcome some of the earlier methodological weaknesses of the school effectiveness literature by using a relatively new statistical technique—hierarchical linear modeling—and applying it to the data on mathematics and science achievement from the National Assessment of Educational Progress (NAEP). Using this technique, two levels of the educational process were modeled—student-level characteristics and school-level characteristics.

The report showed that two of the student-level variables used in the analysis—race-ethnicity and SES—had a consistent impact on science and math achievement in all three grades studied. On average within schools, students from minority backgrounds (controlling for gender and SES) or low SES backgrounds (controlling for gender and race-ethnicity) tended to have lower scores on the NAEP tests. The effect of gender on math and science achievement was more varied. Controlling for race-ethnicity and SES, there were essentially no differences in boys' and girls' math and science achievement in the third grade or seventh grade mathematics. However, boys tended to outperform girls in seventh grade science and in both mathematics and science in the eleventh grade.

None of these results should be particularly startling, nor did the report have to use HLM to arrive at them. Simpler statistical techniques such as ordinary least-square multiple regression would have arrived at similar results.[25] However, by using HLM the report was also able to examine the effects of school characteristics on average mathematics and science achievement, while taking into account the precision of the within-school estimates. Furthermore, HLM allowed the examination of the impact of school-level variables on the effects of the student-level variables. That is, new hypotheses were tested about the effect of school characteristics on the gap between minority and non-minority achievement, the gap between boys and girls' achievement, and the differentiating effect of SES on achievement.

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[23] U.S. Department of Health, Education, and Welfare, J. Coleman, *Equality of Educational Opportunity* (Washington, D.C., 1966).

[24] To be more exact, students are imbedded within classrooms within schools. That is, the process actually has three levels rather than merely two. Micro-computer packages which can handle three-level models are available. However, this analysis could not included classroom-level variables because there were not enough students per classroom in the NAEP sample.

[25] The results would not necessarily be identical however. The within-school results reported here are an average of all of the regression equations run separately for each school, weighted by the inverse of the precision of their estimates. The coefficients from an overall regression equation may be slightly different than the one reported here.

Furthermore, because three grade levels—third, seventh, and eleventh—were examined, inferences could be made about the effect of school-level variables within different grades. For example, achievement was generally lower in schools serving relatively more "disadvantaged" populations. However, while this effect was large in grade three it was usually negligible in grades seven and eleven. Therefore, the effect of attending a school with more disadvantaged students was primarily a factor in grade three. The explanation for this result might be found in differences between grades in tracking or other factors.

Of all the school-level characteristics, the student body characteristics had the most associations with both average achievement and the effects of gender and SES. In both subjects and all three grades, schools with higher percentages of black students, Hispanic students, and disadvantaged students averaged lower achievement than other schools. These outcomes are also not new. However, the use of HLM makes it possible to separate the association of race-ethnicity and SES with student achievement at the individual level from the association of the race-ethnicity and disadvantaged level of the student body with average student achievement at the school level. These associations need to be investigated further at each level.

The result that average achievement in grade three is more affected by the disadvantaged level of the student body than achievement in grades seven or eleven is surprising and needs more investigation. One possible explanation is that in the higher grades, tracking separates the more advantaged and/or high-achieving students into separate classrooms, where their high achievement is encouraged. This increases the school average achievement level despite the overall disadvantaged level of the school. Whereas in grade three, all students are in the same classrooms. In disadvantaged schools, more third grade students in each classroom may lack the foundations of math and science due to fewer pre-school educational experiences, and teachers may need to concentrate on teaching more basic concepts. Thus, potentially high-achieving third grade students may receive less attention in disadvantaged schools than in other schools, causing the average achievement in grade three in disadvantaged schools to be lower.

In third grade math, girls averaged higher achievement than boys in schools with higher percentages of blacks. Since the effect of gender controlled for race-ethnicity, this finding suggests that all girls do better than all boys in schools with higher percentages of black students. More information is needed to interpret this result. In grades seven and eleven in both subjects, SES had less of a differentiating effect in schools with higher percentages of black and/or Hispanic students. However, it is unclear whether this was related to a more restricted range of SES in schools with higher minority populations or to another factor.

Controlling for the student body characteristics, some of the other school characteristics in the other four models were also associated with average achievement—four characteristics in grade three, four in grade seven, and six in grade eleven. In addition, four characteristics were associated with the effects of gender or race-ethnicity—one in grade three, one in grade seven, and two in grade eleven.

Achievement in third grade was associated with factors related to the structure of the classrooms and schools. Math and science achievement were higher in grade three in larger schools, in those with team-taught classes, and in those with third grades organized by departments. Third graders might do better in larger schools because these schools may have more staff and flexibility to organize third grade into a variety of learning environments and/or to allocate staff into teams. However, higher student/teacher ratios were associated with lower average science achievement in all sizes of schools, so successful larger schools organize third grades so that students have access to as many teachers as possible. Higher student/teacher ratios were also associated with lower science achievement of girls in relation to boys, so schools where there are more teachers per student might be especially better for third grade girls.

In grade seven, higher achievement was associated with factors related to school structure, academic standards, fiscal and physical resources, and teacher characteristics. Schools with math tracking averaged higher achievement in both math and science, implying that math tracking improves overall math achievement, which in turn boosts science achievement. In addition, schools that recently had the most increases in academic standards averaged the lowest math and science achievement, which at first seems nonsensical. However, these schools most likely implemented these changes due to low achievement and the changes may not yet have had an effect. It is also possible that these changes will never be associated with higher achievement. Schools with higher achievement averages may or may not already have these standards in place, but they may not feel the need to change them because of their high average achievement. Therefore, it would always be the schools with lower achievement averages that would implement these changes. However, one academic standard among the list of changes was associated with higher math achievement in grade seven, whether or not schools had recently changed it. Schools in which more homework was given averaged higher math achievement in grade seven. This reinforces the value of homework for math achievement, although not for science achievement, in this grade.

Math achievement was also higher in grade seven in schools with more instructional funds per student, although it is not possible to tell what these funds were spent for. The average science achievement of girls in grade seven, already behind that of boys, was even lower in schools where there was more parent/teacher interaction. This parent/teacher interaction could reflect general parental participation in their children's education. Although this participation would be expected to raise achievement for all students, boys may have benefitted more than girls due to assumptions on the parents', boys', and/or girls' parts that it is important for boys, but not girls, to do well in science.

Math and science achievement in the eleventh grade, as in the seventh grade, was associated with factors related to academic standards, fiscal and physical resources, school structure, and teacher characteristics. Schools with more homework averaged higher achievement in both math and science, which emphasizes the value of homework in this grade. Schools with specialized science laboratories and science tracking also averaged higher math and science achievement. Having both specialized labs and science tracking could reflect the importance of science achievement in these schools. In addition, science skills are based on math skills, and these resources could result in the encouragement of math achievement as well. Conversely, schools with general science labs had lower science achievement, reflecting perhaps their lack of investment in more specialized facilities.

Math achievement in eleventh grade was also higher in schools that were larger and/or had more instructional funds. Larger schools and those with more funds would be more likely to be able to provide higher-level math courses, which would push the average achievement level up. Although math tracking was not significantly associated with achievement, it still may have had an influence. In this sample, over three-quarters of the schools had math tracking, while only two-thirds had science tracking, so there might not have been enough variation in math tracking to make a statistical difference. By contrast, the size of schools and amounts of funds varied widely, so their associations with higher achievement levels would be captured more easily by this analysis.

Larger schools were not best for all eleventh grade students. Girls, who already averaged lower math achievement than boys, averaged even lower math scores than boys in larger schools. If larger schools do have more higher-level math courses, this result might reflect the fact that boys were most likely encouraged to attend them. It might also point out that efforts are needed by larger schools to prevent girls from falling behind boys in math. One teacher characteristic was associated with the eleventh grade math achievement of black, Hispanic, and Native American students in relation to white and Asian students, but the finding was puzzling. The gap between minority and non-minority students was wider in schools where teachers spent relatively more time on academic tasks. It would appear that the academic time they were spending was not helping the minority students. However, a third, unmeasured variable could explain this result.

This analysis has identified a group of school characteristics that are associated with math and science achievement when both student-level and school-level characteristics are taken into account. While these results need to be corroborated by more studies, they can be validated informally to the extent that they ring true for educators working on improving achievement in the schools for all groups of students. These findings point out the importance of not overgeneralizing school effectiveness studies carried out in one grade or school level to other grades or school levels. As shown here, conclusions about the impact of school characteristics on student achievement in each grade did not necessarily apply to the other grades. In addition, these results also illustrate how school characteristics can have different impacts on students based on their gender, race/ethnicity, and SES.

While many of the school-level variables examined here had no significant impact on student achievement, this should not be particularly surprising. This analysis by its nature had several purposes. One of the goals was to demonstrate how school effectiveness issues could be explored with NAEP data. Although several researchers have used HLM to explore these issues, no one has used this technique on the NAEP database. Most of the research has been conducted on datasets consisting of a single grade or cohort of students (such as High School and Beyond).[26] While the NAEP data could not be used for a longitudinal analysis of school effects, NAEP had some strengths as a cross-sectional dataset. It allowed an examination and comparison of school effects in several distinct grade levels within the same year rather than an analysis of different grades only as a given cohort moves through them. In addition, NAEP provided many school-level and student-level variables that were called for by the school effects literature and were appropriate for use in hierarchical linear models.

However, NAEP also had some characteristics that could have contributed to the low number of significant results. The use of plausible values for the achievement scores affected the HLM school-level coefficients in two ways. First, it required the calculation of standard errors for the regression estimates that included both sampling and measurement error. While the inclusion of both types of error increased the accuracy of the analysis, it also increased the size of the standard errors, which decreased the number of significant coefficients.[27] Second, other studies using NAEP have shown that if variables not used to impute the plausible values are used in regression models, their coefficients are underestimated, although the sign is accurate. These smaller coefficients, along with the larger standard errors, could have also decreased the number of significant coefficients.

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[26] Most of this research has been conducted by Anthony Bryk, Stephen Raudenbush, and their colleagues at the University of Chicago and Michigan State University, or Harvey Goldstein and his colleagues at the University of London. For a review of much of this research with hierarchical linear models see D. Bock, *Multilevel Models in Educational Research* (New York: John Wiley and Sons, 1989).

The cross-sectional nature of the NAEP data could also be responsible for fewer results. The assumption that student achievement can be explained by the characteristics of the students' current school may be inaccurate. Without data on the characteristics of students' past schools, data on the current school may not be relevant enough to explain current achievement patterns.

Finally, the variables available in NAEP may have been inadequate to explain student achievement. The variables used in this analysis were the best indicators of school effects that were available in the NAEP data sets. However, it is possible that other unmeasured variables might be better measures of school effects, and would be more likely to be significantly associated with achievement. In addition, many researchers believe that classroom-level variables have more of an effect on student achievement than school-level variables. However, because there were not enough students per classroom in NAEP for a classroom-level analysis, the effect of these variables could not be explored.

There were also other reasons to expect few results from the NAEP variables. Many of the school characteristics were included in this study because they are part of the traditional set of variables used in school effectiveness studies. Some of these, such as the fiscal resources variables, have been shown in the past to be poor predictors of student performance, and it was expected that they would also be found wanting in this analysis. In fact it is noteworthy that the three of the fiscal resources—amount of funds, specialized science labs, and general science labs—were significant while taking into account the precision of the within-school estimates.

Another purpose or goal of the analysis was to demonstrate the utility of using hierarchical linear models in school effectiveness research. Despite few significant results, the potential for using HLM in school effectiveness studies was demonstrated. HLM allowed the prediction of student achievement by school-level characteristics, while taking into account the precision of the within-school estimates. Modeling the multi-level nature of these data made the estimates more accurate. In addition, using HLM allowed the estimation of the effects of school characteristics on the within-school effects of gender, race-ethnicity, and SES. Identifying the school-level factors associated with lower achievement by girls and minorities or with the differentiating effects of SES can help to find ways to mitigate these effects within schools.

The emphasis on school effectiveness research explains why few variables were associated with or explained the variation in the effects of race-ethnicity, SES, or gender. Other, unmeasured variables might better explain the variation in these effects. The hypotheses that were tested in this analysis were all based on theories of school effects on achievement. The models used did not reflect the many stratification and discrimination theories that seek to explain the effects of race-ethnicity, SES, or gender on attainment. Hypotheses that would apply these theories to achievement and use HLM to test them would be the next step in this analysis program.

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[27] P. Kaufman, C. Arnold, and M. Wilson, "Using Plausible Values in Hierarchical Linear Models" (technical report prepared for the National Center for Education Statistics, U.S. Department of Education, January, 1991) and W. Fuller, *Measurement Error Models* (New York: John Wiley and Sons, 1987).

Appendix A

Technical Notes

Technical Notes

Variables

The variables used in this analysis are listed in table A1. Field names from the appropriate NAEP data file are provided in table A1 for those variables used directly from the files. "Composite" in the field name column indicates that the variable was created for this analysis from several other variables. "Dummy" in the field name column indicates that the variable was transformed into one or more dummy variables.

Table A1.--Variables used in the analysis

Field Name	Variable Label
	Student level variables
Dummy	Gender
Dummy	Race-ethnicity
Composite	Student socioeconomic status
	School level variables
Student body characteristics	
PCTBLK	Percentage of black students
PCTHSP	Percentage of Hispanic students
Composite	Disadvantaged index
Fiscal and physical characteristics of school	
SIDP	Instructional dollars per pupil
NMICROS/SNSTUDA	Micro-computers per student
C024401	Y/N Science lab facilities in classroom
C024402	Y/N General purpose science labs
C024403	Y/N Specialized science labs
School program structure	
C023302	Y/N Math tracking by ability
C023303	Y/N Science tracking by ability
Dummy	Classroom organization
SNSTUDA/SNTCHA	Student/teacher ratio
SNSTUDA	Student enrollment

Table A1.--Variables used in the analysis--Continued

Field Name	Variable Label
School academic standards	
Composite	Rigor of current standards
Composite	Change in standards
T008901	Amount of homework assigned
Composite	Teacher control over academic standards
Principal and teacher characteristics	
C020401	Years principal of school
C020501	Principal years administrative experience
C020601	Principal years prior teaching experience
Composite	Principal time spent on academic tasks
C021307	Principal time in parent/community relations
C022201/SNTCHA	Percentage of teachers in minority groups
Composite	Teacher time spent on academic tasks
Composite	Amount of parent/teacher interaction

The specific variables included in each composite and dummy variable are shown in table A2. If the component variables were standardized, this is indicated under the variable name. The creation and construction of these variables are discussed after the table.

Table A2.--Composite and dummy variables

Variable Name	Field Name	Variable Label
Gender	DSEX	Females = 1 Males = 0
Race-ethnicity	DRACE	Minority = 1 (DRACE=black, Hispanic, or American Indian) Non-minority = 0 (DRACE=white or Asian)
Student socioeconomic status (standardized)	B003501A	Mother's education
	B003601A	Father's education
	B003901A to B003905A	Material possessions in home
	B004401A	Family owns computer
Disadvantaged index (standardized)	NQCHAP1	Number of children qualify Chapter 1
	NRCHAP1	Number of stud. receiving Chap. 1
	SPLUNCH	Percentage of students in school lunch program

Table A2.--Composite and dummy variables--Continued

Variable Name	Field Name	Variable Label
Classroom organization	C023101	Self contained = 1 Other = 0
		Team taught = 1 Other = 0
		Departmentalized = 1 Other = 0
Rigor of standards	C024103	Y/N Need to pass reading competency
	C024106	Y/N Need to pass math competency
	C024110	Y/N Need to pass science competency
	C025502	Y/N Parents informed of low grades
	C025503	Y/N Parent informed if child sent to office
Change in standards	C025402	Y/N Lengthened school year
	C025403	Y/N Increased homework
	C025404	Y/N Increased course offerings
	C025405	Y/N Increased grad. requirements
	C025406	Y/N Implemented competency test
	C025407	Y/N Established new conduct code
	C025408	Y/N Established stricter attend. policy
	C025409	Y/N Establish grade req for sports
Teacher control over academic standards	T009501	Teacher control set sch. behavior
	T009502	Teacher control set instr. goals
	T009503	Teacher control select materials
	T009504	Teacher control decide content/topic
	T009505	Teacher control sequence taught
	T009506	Teacher control group students
	T009507	Teacher control evaluate students
	T009508	Teacher control student discipline
Principal time academic	C021302	Principal time: curriculum
	C021303	Principal time: teacher supervision
	C021304	Principal time: working with teachers
	C021306	Principal time: working with students
Teacher time academic	T007901	Teacher time: instruction
	T008105	Teacher time: supervising students
	T008401	Teacher time: leading class
	T008402	Teacher time:work in small groups
	T008403	Teacher time:with individual students
Level of parent/teacher interaction (standardized)	T009801	Do you attend PTA?
	T009802	Parent/teacher conferences?
	T009803	Provide suggestions to parents?
	T008107	Time spent comm. with parents

Creation of Dummy Variables

Three dummy variables were created from the NAEP variables. The derived NAEP variable for gender was used to create the gender variable, by changing the codes to make males the reference group. The derived NAEP variable for race-ethnicity was changed into a dummy variable by designating blacks, Hispanics, and American Indians as minority and whites and Asians as non-minority.[28] Whites and Asians were grouped together because the average NAEP scores of these groups were similar and the average scores of the other groups were all much below whites and Asians.[29] In addition, Asians often averaged higher scores than whites, and the purpose of the race-ethnicity variable was to examine the school effects on the achievement gap between the whites and groups who averaged lower scores than whites. The non-minority group was used as the reference group.

The NAEP variable for classroom organization, CO23101, was converted to three dummy variables. Each type of classroom—self-contained, team-taught, and departmentalized—formed one dummy variable. In each grade, the type of classroom that predominated was designated as the reference group, and that dummy variable was left out of the analysis.

Scale Construction of Continuous Variables

The construction of the continuous composite variables was handled in the following manner. First, items were selected from the school, principal, and teacher questionnaires which seem on face value to represent aspects of the desired concept. Second, the scale's dimensionality was assessed by factor analysis. Third, if the scale appeared to be reasonably unidimensional, the internal reliability of the scales was assessed with Cronbach's alpha. Each item whose deletion would raise the scale's alpha was deleted from the scale and the scale's reliability was recalculated, until deletion of any variable in the scale would decrease the scale's reliability (as measured by Cronbach's alpha). During this process special care was taken so as to make the scales for each cohort as comparable as possible. That is, the decision to delete one or more variables from the composite also was based on the impact that deletion of the variable will have on the comparability of the scale across cohorts.

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[28] There are only five categories of race-ethnicity in NAEP.

[29] See J. A. Dossey, et al, *The Mathematics Report Card: Are We Measuring Up? Trends and Achievement Based on the 1986 National Assessment* (Princeton, New Jersey: ETS, 1988) and I.V.S. Mullis and L.B. Jenkins, *The Science Report Card: Elements of Risk and Recovery. Trends and Achievement Based on the 1986 National Assessment* (Princeton, New Jersey: ETS, 1988).

Table A3.--Reliability Analysis of Composite Variables

Scale	Final Reliability		
	Grade 3	Grade 7	Grade 11
Student socioeconomic status	.589	.578	.548
Disadvantage index	.703	.682	.659
Rigor of standards	.873	.931	.802
Change in standards	.637	.620	.587
Teacher control over academic standards	.787	.732	.753
Principal time academic	.743	.731	.764
Teacher time academic	N/A	.514	.344

Table A3 displays the reliability of the composite variables. Most of these reliabilities fall within the range of NCES composite variables. The student socioeconomic status variable has a slightly lower reliability in each grade, but since it was the best measure of SES available, it was included. The change in standards variable has a slightly lower reliability in grade eleven than in the earlier grades, but the same variables were retained to insure comparability across grades. The lowest reliability was found in the teacher time academic variable in grade eleven. Its reliability in grade seven was somewhat low as well. However, because teacher academic time was an important concept in school effects literature, the scale was kept as a variable.

Once the reliability of the composites had been assessed, the actual construction of the composites took place. To insure comparability of the variables used in this analysis for each cohort, composites were constructed for each cohort in a similar manner. In all instances the non-missing values for the component variables were averaged. If the component variables were measured on different scales, then the values were standardized before averaging (unit weighting). This allowed schools or students to have unbiased values on the composite variable even though they had missing values or different scales for some of the component variables.

Table A4 lists the ranges and the unstandardized means and standard deviations of all variables used in this analysis.

Table A-4.--Unstandardized means and standard deviations for within-school and between-school independent variables, by grade: 1985-86.

Variable (range)	Grade 3		Grade 7		Grade 11	
	Mean	(s.d.)	Mean	(s.d.)	Mean	(s.d.)
WITHIN-SCHOOL						
Gender - percent female (0-1)	0.49	(0.10)	0.46	(0.14)	0.49	(0.13)
Race-ethnicity - percent minority[1] (0-1)	0.34	(0.30)	0.39	(0.37)	0.30	(0.31)
SES level (standardized)	0.01	(0.27)	-0.03	(0.25)	-0.05	(0.26)
BETWEEN-SCHOOL						
Percent black (0-100)	18.65	(28.12)	28.43	(33.51)	18.41	(25.37)
Percent Hispanic (0-100)	12.11	(21.33)	10.99	(19.84)	10.50	(16.32)
Disadvantaged level (standardized)	0.12	(1.11)	0.03	(0.96)	-0.04	(0.81)
Instructional funds/student (1-9)	6.95	(1.52)	6.94	(1.56)	6.79	(1.63)
Microcomputers/student	0.03	(0.02)	0.03	(0.02)	0.04	(0.03)
Have classroom science lab (0/1)	0.17	(0.35)	0.57	(0.44)	0.80	(0.37)
Have general science lab (0/1)	0.15	(0.34)	0.67	(0.43)	0.78	(0.38)
Have specialized science lab (0/1)	0.01	(0.10)	0.30	(0.40)	0.78	(0.39)
Classroom organization:[2]						
Team-taught classes (0/1)	0.08	(0.27)	0.09	(0.28)	0.00	(0.05)
Department structure (0/1)	0.06	(0.24)	0.63	(0.48)	0.84	(0.37)
Self-contained classrooms (0/1)	0.73	(0.45)	0.09	(0.28)	0.04	(0.19)
Have math tracking (0/1)	–	–	0.61	(0.44)	0.77	(0.40)
Have science tracking (0/1)	–	–	0.38	(0.44)	0.67	(0.44)
Student/teacher ratio	21.22	(6.25)	19.88	(5.58)	22.00	(14.09)
School size (number of students)	475.17	(230.38)	644.12	(357.43)	1069.75	(732.92)
Rigor of academic standards (0-1)	0.48	(0.27)	0.46	(0.23)	0.40	(0.23)
Change in academic standards (0-1)	0.37	(0.30)	0.38	(0.30)	0.48	(0.26)
Amount of homework (1-7)	3.90	(1.12)	4.42	(1.06)	4.48	(1.04)
Amount of teacher control over standards (1-5)	3.60	(0.18)	3.49	(0.50)	3.60	(0.46)
Principal years as principal	5.94	(5.23)	6.35	(4.74)	6.41	(4.75)
Principal years in ed. admin.	14.25	(6.90)	13.76	(6.23)	14.34	(6.11)
Principal years teaching	8.96	(4.44)	8.91	(3.84)	9.08	(4.73)
Amount of principal time academic (1-5)	3.71	(0.82)	3.51	(0.84)	3.80	(0.82)
Amount of principal time with parents (1-5)	3.49	(1.03)	3.26	(1.04)	3.39	(1.10)
Percent teachers in minority groups (0-1)	0.20	(0.23)	0.22	(0.26)	0.17	(0.21)
Amount of teacher time academic (1-7)	–	–	4.06	(0.94)	3.68	(0.63)
Amount of parent/teacher time (stand.)	-0.06	(0.26)	0.00	(0.47)	0.00	(0.46)
N (before sampling)	372		265		371	

[1] Minority students were black, Hispanic, or American Indian. Non-minority students were white or Asian.

[2] Does not add to 100 because missing cases were included in distribution.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

HLM Methodology

The HLM analysis and software program requires many decisions to be made about data handling before and during the HLM analysis. Some of these decisions simply affect the ability of the HLM software to handle the data; others affect the interpretation of the results. These technical notes record and clarify the decisions made in this analysis about data handling, and how the results can be interpreted given these decisions.

Weighting

These analyses were weighted using both the student weights and the school weights provided by NAEP to reflect the sampling design and response rates. These weights were normalized so they would provide the same proportionate weighting of each case, but sum to the unweighted sample size. Using the actual weights would have produced a sample that was inappropriately large for the HLM statistical tests.

Sampling

The PC version of HLM can handle 300 between-unit cases, or, in our case, schools. While our NAEP sample of grade 7 had about 260 schools, grades 3 and 11 had about 370 schools. Consequently, 300 each of the grade 3 and 11 schools were sampled randomly without replacement and used for this analysis. The number of students was thus limited to those from the 300 sampled schools.

Missing Values

HLM allows missing values in the within-unit variables, i.e. at the student level. There were no missing values in the gender or race-ethnicity variable, but the missing values in the SES variable reduced the within-school cases considerably, sometimes to a point of eliminating the entire school from the analysis.

HLM does not allow missing values in the between-unit variables, so schools with missing values on these variables were given the mean value of the variable across all schools. A few variables with more than twenty percent missing were dropped from the analysis.

For missing between-unit dummy variables, another variable was added to indicate when it was missing. This added to the number of variables in each model (see next section).

Limits on number of variables

The number of variables allowed in the sufficient statistics files and in each equation were limited by the PC version of HLM. The sufficient statistics files were limited to 25 within-unit variables (this analysis included only 4) and 25 between-unit variables (this analysis included potentially 36). However, this was not a problem because between-unit variables were not added to the models cumulatively; groups of variables (models) were tested separately. Variables could thus be divided into two separate sufficient statistics files (for each subject and grade) and the appropriate file could be used for each model.

Within the models, the number of variables were limited to 10 within-unit variables (this analysis included 4), and 15 between-unit variables in any one equation, with a limit of 35 total between-unit variables, including the base values, in any one model. While the models in the analysis rarely had 15 between-unit variables in any one equation, they often had more than 35 total variables (there were 4 within-unit parameters to explain, times up to 10 between-unit variables, including dummy missing variables, for a total of up to 40 variables). Therefore, for each model, as many of the variables as would fit were first put into the first version of the model. Then, for each subject/grade combination, variables that were neither significant nor theoretically important were dropped, until all the variables in the model had been tested. In the tables, variables with no coefficients in the final model, i.e. blanks in the table, have been tested in previous models and found insignificant and were not included in the final model. This is also true of variables not in the table, unless the variable was not available for that particular grade.

The limits on the number of variables often resulted in a different equation for each subject/grade combination for the same model, which limits somewhat the comparability of the models across subjects and grades. However, the models can be compared within subjects and grades, which was thought to be more important. Another consequence of these limits was that most models were not tested with all hypothesized variables at once. While only nonsignificant and theoretically less-important variables were eliminated from any model, it is possible that the results would have been different for both included and excluded variables had they all been in the model.

Centering

The within-unit variables – gender, race-ethnicity, and SES were centered – their school means were subtracted from their value, so their new mean would be zero. Since dummy variables were used for gender (female=1; male=0) and race-ethnicity (blacks, Hispanics, American Indians and others=1; whites and Asians=0), the mean of these values was the percentage of females or minorities in that school. The difference between the two values on either variable was still one, with the females and minorities having the positive values, and the males and whites/Asians having the negative values.

The main reason for centering was to be able to interpret the intercepts of the within-unit equations in the following way. Since the intercept was the average level of achievement in a school when the three predictors were at zero, and since zero was their mean, the intercept was the level of average achievement in each school at "average" gender, race-ethnicity, and SES. Although there is no real "average" gender or race-ethnicity, this achievement level can be seen as the average achievement before the effects of gender, race-ethnicity, and SES have been taken into account. Since the intercept becomes the dependent variable in the first between-school equation, this equation can be interpreted as predicting the average achievement in each school overall, rather than for some limited group, such as the achievement of white males of average SES. This provides a baseline, if hypothetical, level of average achievement which the parameters of gender, race-ethnicity, and SES can then alter.

While centering did not change the value of the Beta coefficients of gender, race-ethnicity, or SES, it did allow a more descriptive interpretation of these coefficients. In the case of the dummy variables, the coefficients still represented the average difference in the number of achievement points between males and females, and between minorities and whites/Asians. If the coefficients were positive, the females and minorities were doing that much better than males and whites/Asians. If the coefficients were negative, females and minorities were doing that much worse. The only difference was that instead of seeing the coefficients as the values for females or minorities, these same coefficients were interpreted as the "gap" between females and males, or between minorities and whites/Asians, since zero was not males or white/Asians, but somewhere between the dichotomous values. These Beta coefficients, or parameters, are the dependent variables in the between-school equations, and will be referred to in the text as the "gender gap" between girls and boys in achievement, or the "minority gap" between minorities and whites/Asians in achievement.

In the case of SES, the continuous variable, the value of SES was positive above its mean (zero) and negative below its mean, instead of going from zero to a higher value. A positive SES coefficient would push the SES value away from zero in either direction, pushing the achievement level in the corresponding direction and creating a larger difference in achievement between students of high or low SES. A negative coefficient would push the SES value towards zero from either direction, reducing the change in achievement level and creating a smaller difference in achievement between students of high or low SES. The Beta coefficient on SES could thus be interpreted as the "differentiating effect" of SES, and will be referred to in this way in the text.

An issue in centering in HLM models is whether and how to include the school means of each of the centered within-unit variables in the between-unit equations. It is generally agreed that they should be included, unless the researchers want all the schools to be treated as if they have the same means on these variables, since all of these means have been set to zero.[30]

If the school means are going to be included, it must be decided whether to include the means for each school from the sample, or to use school means from another source. The most accurate source is recommended. In the case of the NAEP student-level file, the school means of individual gender, race-ethnicity, and SES would have been based on small samples of students from each school. However, NAEP provided excellent school-level measures of student body race-ethnicity and disadvantaged level, a measure similar to SES. Therefore, the more accurate school-level measures of percent Black, percent Hispanic, and disadvantaged level of the student body were chosen as proxies for the school means of race-ethnicity and SES. There were no single-sex schools since the sample was of public schools only, so the gender mean was assumed to be constant at 51 percent and not included. However, this illustrates the dilemma of wanting to center a within-unit independent variable in order to make the intercept of the within-unit equation a true average but not having a between-unit measure of the mean of that variable. This issue needs more discussion among HLM researchers.

Standardizing

All the between-unit, school-level variables, were standardized, so the size of their coefficients, or Gammas, could be compared across variables within subject and grade. As in regular linear regression models, the school-level variables with significant coefficients are interpreted as predicting, for every unit change in that variable, a change in the dependent variable (in this case the Beta coefficient or intercept) by the amount of the Gamma coefficient. The between-school variables were all standardized to a mean of zero and a standard deviation of 1, so their unit changes were in standard deviation units. The coefficients of the between-school variables, the Gammas, thus predict how much the dependent variable will change for every standard deviation of these between-school variables. This change is predicted for every level of, i.e. controlling for the effects of, the other independent variables in the equation. Since each independent variable is in standard deviation units, the coefficients of these variables can be directly compared within each model to see which variables have the largest coefficient or effect on the dependent variable, the within-school Beta coefficient or intercept. In order to further interpret these standardized units, table A-4 provides the unstandardized means and standard deviations for the between-school variable. In addition, table A-4 shows the across-school means and standard deviations of the within-school variables gender, race-ethnicity, and SES.

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[30] For a technical discussion of these and other centering issues see S.W. Raudenbush, "'Centering' Predictors in Multilevel Analysis: Choices and Consequences." *Multilevel Modeling Newsletter 1(2)* (1989): 10-12; N.T. Longford, "To Center or Not to Center," *Multilevel Modeling Newsletter 1(3)* (1989):7; I. Plewis, "Comment on 'Centering' Predictors in Multilevel Analysis, *Multilevel Modeling Newsletter 1(3)* (1989): 8-10.

Approximations for Measurement Error Variability

NAEP used item response theory (IRT) to estimate proficiency scores in mathematics and science for each individual student. However, these proficiency scores are latent variables conditional on the student's responses to several cognitive and background items and *are not directly observed.* That is, proficiency scores were predicted from a set of cognitive and background variables (referred to as conditioned variables). Because the proficiency scores are not observed but estimated, there is some amount of uncertainty or variance associated with them. Thus, rather than having a single observed math or science score, there is a range or distribution of plausible values for each sampled student's proficiency in mathematics and science. The variance in these scores reflects the errors in measurement. In this analysis there are five such plausible values for each sampled student resulting from five random draws from the conditional distribution of proficiency scores for each student. The parameter estimates from the HLM analyses were based on the average parameter estimates from separate HLM analyses of the five plausible values. That is, a separate HLM analysis was conducted on each of the five plausible values and the results from these analyses was averaged.[31] The variance for the final parameter estimates consisted of two components—sampling error and measurement error.

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[31] The HLM parameter estimates that were averaged for this report included the Gammas, the parameter variances, the reliabilities, the percentages of parameter variance explained, and the probabilities of the parameter variance being zero.

The following routine was used to approximate the component of error variance in the analysis due to the error in measurement and to add it to the sampling error:

Let $\widehat{\theta}_m$ represent the m^{th} plausible value, where m=1 to M sets of plausible values (in our case M=5). Let $\hat{t}_m$ represent the parameter estimate based on the m^{th} plausible value. Let U_m represent the variance of $\hat{t}_m$, or the sampling error.

- Five HLM runs were conducted based on each plausible value $\widehat{\theta}_m$. The parameter estimates from these runs were averaged:

$$t^* = \frac{\sum_{m=1}^{M} \hat{t}_m}{M}$$

- The variance of the parameters from these runs were averaged:

$$U^* = \frac{\sum_{m=1}^{M} U_m}{M}$$

- The variance of the M estimates $\hat{t}_m$ was estimated:

$$B_m = \frac{\sum_{m=1}^{M} (\hat{t}_m - t^*)^2}{(M-1)}$$

- The final estimate of the variance of the parameter estimate is the sum of the two components:

$$V = U^* + (1 + M^{-1})\, B_m$$

The square root of these variances were then used in a standard Student's t formula for evaluating the statistical significance of each parameter.

Statistics in Supporting Tables

Tables B6-B41 in Appendix B are the supporting tables for HLM results presented in chapters II and III. These tables include the Gammas, their significance level, and the percent of parameter variance explained by each model that are shown in the text tables. The supporting tables also include the standard errors of the Gammas, the t value and significance of the Gammas, the reliability of the parameters (which in HLM analysis is the percent of total variance that is parameter variance for each parameter), the actual parameter variance, or Tau, still present after each model has been run, the degrees of freedom at the school level for each between-school model, and an estimate of the probability that Tau is greater than zero given those degrees of freedom. This section explains these statistics in greater detail.

Gammas and standard errors

The Gammas and their standard errors were calculated as discussed in the previous "Approximations for Measurement Error Variability" section. Each Gamma is the average of the five Gammas from five separate HLM analyses, using the five plausible values of achievement. Each standard error is the average of the five standard errors from the five Gammas, plus the standard error between the five Gammas. This allowance for measurement error thus increased the standard errors over those obtained for just one plausible value, and made it harder for the school effects to be significant. While this limited the number of significant school effects, it lent greater confidence to the results that were significant.

Significance tests on Gammas

Significance was calculated for each Gamma with a t value, which was the value of the Gamma divided by its standard error. The probability of this t value being larger than zero was determined with a two-tailed test of significance, using the alpha levels of .05 and .01 for each Gamma. It is possible that since so many parameter estimates were made in each analysis, lower alpha levels should be used to prevent the build-up of Type I error. This procedure was not followed because other HLM studies have not done so in the past and because this was an exploratory study. However, the issue of appropriate significance tests and the meaning of significant Gammas needs to be discussed among HLM researchers.

Parameter Variance

Parameter variance, or Tau, is the actual variation between schools around the parameters of the intercept and the gender, race-ethnicity, and SES coefficients in the within-school equations. The parameter variance usually changes between models. It is highest in the average within-school models, where it indicates how much variance there is around each of the four parameters before any between-school variables are taken into account. The purpose of the between-school models is to explain, or reduce this parameter variance.

If the parameter variance is zero, as indicated by a Chi Square test, either in the within-school models or after any between-school models, then there may be no more parameter variance to explain. This test is commonly used in HLM analysis to decide if more variables need to be added to the model, for if there is no more variation or if there was not any to start with, then between-school models or more between-school variables are not needed to explain it. However, since this analysis tested variables in separate theoretical groups rather than by hierarchically entering them in one large equation, this test was not used to determine whether a model was needed or what variables should be added. However, the average of the probabilities of the Chi Square tests are presented so that the reader can interpret the levels of parameter variance before and after the between-school models.

R^{2*}, *or Percent of Parameter Variance Explained*

If there is still parameter variance to explain, a measure of how well each model explains the parameter variance is the R^{2*}. It is similar to a linear regression R^2 in that it represents the proportion of the original parameter variance that was explained by a particular between-school model. To obtain the R^{2*} for a parameter in a between-school model, the difference between the original parameter variance in the within-school model and the parameter variance left after the between-school model is divided by the original parameter variance.

Reliability

In HLM, reliability refers to the percentage of the total variance around each parameter that is parameter variance. The total variance of each parameter consists of both parameter variance and sampling variance. Parameter variance is the actual variation between schools around the parameters of the intercept and the gender, race-ethnicity, and SES coefficients in the within-school equations. This variation can be explained by the between-school models. However, there is also sampling variance around these parameters, from sampling error within the schools, and this cannot be explained by the between-school model because it is essentially error. Reliability thus indicates how much of the total variance can be explained by the between-school models.

While knowing the R2*, or percentage of parameter variance explained is very important information about the models, the interpretation of the R2* depends on the level of reliability. The percentage of total variance explained by these models is R2* times the reliability. The larger both R2* and the reliability, the larger the percentage of total variance in achievement that these models explain.

Appendix B

Supporting Tables

Descriptive Tables

Table B1.--Average mathematics and science scores for third-grade students by selected characteristics

	Average mathematics score*	Average science score*
Student characteristics		
Gender		
Male	210.0	209.0
Female	206.3	207.7
Race-ethnicity		
Nonminority	218.1	222.5
Minority	187.2	178.9
Socioeconomic status		
Low	194.5	192.7
Medium	210.1	209.7
High	218.1	221.2
Student body characteristics		
Percent of students black		
0%	216.5	220.7
1 to 25%	211.6	213.5
Over 35%	195.3	189.3
Percent of students Hispanic		
0%	213.8	215.8
1 to 10%	210.7	213.4
Over 10%	195.5	189.2
Index of student disadvantage		
Low	224.6	232.0
Medium	216.5	220.7
High	198.6	194.5

Table B1.--Average mathematics and science scores for third-grade students by selected characteristics--Continued

	Average mathematics score*	Average science score*
Parental involvement		
Amount of parent/teacher interaction		
Low	196.3	192.8
Medium	209.9	212.9
High	210.4	208.9
Amount of principal time spent with parents (per week)		
1 to 2 hrs	218.5	223.3
3 to 4 hrs	198.3	195.7
5 to 6 hrs	207.8	208.5
7 or more hrs	195.1	186.5
Academic press		
Promotion standards		
Low	208.9	210.0
Medium	215.8	219.8
High	195.7	189.2
Amount of time principal spends on academic tasks		
Low	216.0	221.3
Medium	202.6	200.4
High	213.4	211.3

Table B1.--Average mathematics and science scores for third-grade students by selected characteristics--Continued

	Average mathematics score*	Average science score*
Resources		
Instructional dollars per student		
$25 to $34.99	215.2	223.4
$35 to $44.99	203.5	205.7
$45 to $54.99	219.6	223.7
$55 to $64.99	206.6	205.4
$65 to $74.99	210.0	217.1
$75 to $149.99	201.0	196.7
$150 and up	220.3	221.0
School has science labs		
No	209.5	211.1
Yes	203.4	199.2
School has general purpose labs		
No	203.7	202.1
Yes	220.6	226.1
School has specialized labs		
No	207.8	207.9
Yes	220	225.9
Relative number of microcomputers in school		
Low	200.4	197.2
Medium	215.8	220.0
High	206.1	204.8

Table B1.--Average mathematics and science scores for third-grade students by selected characteristics--Continued

	Average mathematics score*	Average science score*
Instructional environment		
Student teacher ratio		
Low	214.7	219.2
Medium	204.4	204.8
High	209.6	207.9
Organization of teaching environment		
Self contained	206.3	206.4
Team teaching	213.2	213.1
Departmentalized	215.0	215.9
Amount of teacher influence over teaching environment		
Low	204.7	205.0
Medium	213.3	215.4
High	205.2	203.2
School size		
Small	209.6	212.1
Medium	214.0	217.4
Large	198.2	192.2

* Average of five plausible values

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

Table B2.--Average mathematics and science scores for seventh-grade students by selected characteristics

	Average mathematics score*	Average science score*
Student characteristics		
Gender		
Male	264.0	248.8
Female	266.4	243.3
Race-ethnicity		
Nonminority	272.5	257.0
Minority	247.2	218.7
Socioeconomic status		
Low	248.2	223.7
Medium	266.3	247.7
High	278.5	262.8
Student body characteristics		
Percent of students black		
0%	271.1	256.4
1 to 25%	269.0	251.1
Over 35%	251.7	226.6
Percent of students Hispanic		
0%	265.8	245.9
1 to 10%	268.7	252.4
Over 10%	255.1	229.3
Index of student disadvantage		
Low	278.9	263.9
Medium	267.8	250.4
High	255.2	231.2

Table B2.--Average mathematics and science scores for seventh-grade students by selected characteristics--Continued

	Average mathematics score*	Average science score*
Parental involvement		
Amount of parent/teacher interaction		
Low	265.6	246.9
Medium	267.7	248.8
High	260.7	240.5
Amount of principal time spent with parents (per week)		
None	269.9	256.0
1 to 2 hrs	266.0	247.5
3 to 4 hrs	265.9	246.2
5 to 6 hrs	262.2	241.6
7 or more hrs	264.1	245.3
Academic press		
Promotion standards		
Low	266.4	247.2
Medium	265.5	246.7
High	259.8	239.7
Amount of time principal spends on academic tasks		
Low	268.4	249.3
Medium	264.3	244.9
High	262.6	244.0
Amount of teacher time spent on academic tasks		
Low	266.4	247.4
Medium	266.9	248.3
High	261.4	241.3

Table B2.--Average mathematics and science scores for seventh-grade students by selected characteristics--Continued

	Average mathematics score*	Average science score*
Resources		
Instructional dollars per student		
$25 to $34.99	266.6	252.4
$35 to $44.99	264.6	246.4
$45 to $54.99	265.8	247.2
$55 to $64.99	266.9	248.3
$65 to $74.99	265.2	247.0
$75 to $149.99	262.8	240.3
School has science labs		
No	262.6	242.6
Yes	266.3	247.5
School has general purpose labs		
No	263.3	243.7
Yes	265.7	246.6
School has specialized labs		
No	264.4	245.0
Yes	266.5	247.7
Relative number of microcomputers in school		
Low	259.1	239.6
Medium	267.6	248.8
High	264.2	244.5

Table B2.--Average mathematics and science scores for seventh-grade students by selected characteristics--Continued

	Average mathematics score*	Average science score*
Instructional environment		
Students are assigned to math class by ability		
No	261.6	243.5
Yes	266.6	247.0
Students are assigned to science class by ability		
No	261.6	243.5
Yes	266.6	247.0
Student teacher ratio		
Low	266.7	248.3
Medium	265.4	246.0
High	262.7	243.3
Organization of teaching environment		
Multiple	248.0	215.7
Self contained	260.6	243.4
Team teaching	269.5	250.4
Departmentalized	265.3	246.2
Amount of teacher influence over teaching environment		
Low	257.3	234.9
Medium	267.8	249.5
High	268.0	250.4
School size		
Small	267.2	251.3
Medium	265.2	245.7
Large	263.1	241.5

* Average of five plausible values

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

Table B3.--Average mathematics and science scores for eleventh-grade students by selected characteristics

	Average mathematics score*	Average science score*
Student characteristics		
Gender		
Male	306.5	299.1
Female	301.3	282.9
Race-ethnicity		
Nonminority	311.1	302.1
Minority	283.0	258.2
Socioeconomic status		
Low	284.7	263.0
Medium	301.7	288.3
High	320.2	313.7
Student body characteristics		
Percent of students black		
0%	304.4	292.0
1 to 25%	308.2	297.5
Over 35%	289.4	268.5
Percent of students Hispanic		
0%	304.2	291.1
1 to 10%	306.0	294.3
Over 10%	295.2	276.8
Index of student disadvantage		
Low	312.3	303.4
Medium	306.2	294.2
High	294.2	276.7

Table B3.--Average mathematics and science scores for eleventh-grade students by selected characteristics--Continued

	Average mathematics score*	Average science score*
Parental involvement		
Amount of parent/teacher interaction		
Low	303.4	291.1
Medium	305.7	293.0
High	300.7	286.5
Amount of principal time spent with parents (per week)		
None	298.3	286.3
1 to 2 hrs	303.7	290.0
3 to 4 hrs	301.7	288.5
5 to 6 hrs	303.7	290.3
7 or more hrs	306.3	294.6
Academic press		
Promotion standards		
Low	302.4	288.8
Medium	305.8	293.7
High	304.0	290.5
Amount of time principal spends on academic tasks		
Low	301.5	288.3
Medium	305.1	292.9
High	303.0	288.2
Amount of teacher time spent on academic tasks		
Low	300.7	286.3
Medium	303.3	290.7
High	306.7	293.8

Table B3.--Average mathematics and science scores for eleventh-grade students by selected characteristics--Continued

	Average mathematics score*	Average science score*
Resources		
Instructional dollars per student		
$15 to $24.99	326.5	312.9
$25 to $34.99	300.7	289.8
$35 to $44.99	300.6	287.6
$45 to $54.99	304.9	294.6
$55 to $64.99	300.2	287.1
$65 to $74.99	310.3	298.7
$75 to $149.99	303.6	288.1
School has science labs		
No	304.5	291.1
Yes	303.7	290.7
School has general purpose labs		
No	306.6	292.9
Yes	303.1	290.2
School has specialized labs		
No	299.2	286.1
Yes	304.3	291.3
Relative number of microcomputers in school		
Low	300.3	286.6
Medium	302.5	289.1
High	308.9	297.0

Table B3.--Average mathematics and science scores for eleventh-grade students by selected characteristics--Continued

	Average mathematics score*	Average science score*
Instructional environment		
Students are assigned to math class by ability		
No	303.9	290.7
Yes	303.5	290.9
Students are assigned to science class by ability		
No	303.9	290.7
Yes	303.5	290.9
Student teacher ratio		
Low	304.1	290.5
Medium	304.0	291.5
High	303.0	288.4
Organization of teaching environment		
Self contained	304.7	292.3
Departmentalized	303.8	290.7
Amount of teacher influence over teaching environment		
Low	300.9	285.3
Medium	303.1	290.5
High	308.1	296.8
School size		
Small	305.4	291.8
Medium	303.7	292.0
Large	302.6	287.4

* Average of five plausible values

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

Table B4.--Simple correlations of average math score with selected variables

	Third Grade	Seventh Grade	Eleventh Grade
Student characteristics			
Gender (1=female)	-0.017	0.019	-0.074
Race-ethnicity (1=minority)	-0.334	-0.285	-0.207
Socioeconomic status	0.384	0.420	0.412
Student body characteristics			
Percentage of school black	-0.348	-0.328	-0.281
Percentage of school Hispanic	-0.215	-0.162	-0.143
Disadvantaged index	-0.410	-0.281	-0.214
Parental involvement			
Parent/teacher interaction	0.129	-0.015	-0.020
Amount of time spent by principal with parents/community	0.004	0.011	0.060
Academic press			
Promotion standards	-0.092	-0.079	0.025
Principal time academic	-0.041	-0.012	0.024
Teacher time academic	N/A	-0.089	0.025
Resources			
Instructional dollars per student	-0.047	0.033	0.044
School has science labs	0.043	-0.026	-0.011
School has general purpose labs	0.084	0.023	-0.060
School has specialized labs	0.013	0.039	0.078
Number of microcomputers in school	0.083	0.017	0.064
Instructional environment			
Ability tracking in math	N/A	-0.006	-0.023
Ability tracking in science	N/A	0.066	-0.050
Student teacher ratio	-0.039	0.006	0.032
Amount of teacher influence over learning environment	-0.103	0.134	0.143
School size	-0.055	-0.034	-0.047

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

Table B5.--Simple correlations of average science score with selected variables

	Third Grade	Seventh Grade	Eleventh Grade
Student characteristics			
Gender (1=female)	0.003	-0.115	-0.213
Race-ethnicity (1=minority)	-0.379	-0.394	-0.308
Socioeconomic status	0.392	0.470	0.468
Student body characteristics			
Percentage of school black	-0.395	-0.404	-0.341
Percentage of school Hispanic	-0.249	-0.242	-0.176
Disadvantaged index	-0.455	-0.357	-0.256
Parental involvement			
Parent/teacher interaction	0.155	-0.020	-0.012
Amount of time spent by principal with parents/community	0.004	0.009	0.049
Academic press			
Promotion standards	-0.122	-0.077	0.013
Principal time academic	-0.030	-0.013	0.022
Teacher time academic	N/A	-0.087	0.021
Resources			
Instructional dollars per student	-0.077	-0.050	-0.020
School has science labs	0.036	-0.009	0.008
School has general purpose labs	0.088	-0.007	-0.046
School has specialized labs	0.040	0.036	0.066
Number of microcomputers in school	0.098	-0.019	0.065
Instructional environment			
Ability tracking in math	N/A	-0.007	0.014
Ability tracking in science	N/A	0.041	-0.019
Student teacher ratio	-0.058	0.017	0.008
Amount of teacher influence over learning environment	-0.153	0.207	0.162
School size	-0.096	-0.107	-0.083

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Data Tapes.

HLM Tables of Mathematics Achievement

Table B6.--Average within-school predictors of grade 3 math achievement

Predictor	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
INTERCEPT (AVG. ACHIEVEMENT)	208.29	1.07	194.80**
GENDER SLOPE COEFFICIENT	-0.85	0.89	-0.95
RACE SLOPE COEFFICIENT	-14.63	1.54	-9.49**
SES SLOPE COEFFICIENT	10.95	1.00	10.96**

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.95	253.09	243	0.00
GENDER SLOPE COEFFICIENT	0.22	40.48	243	0.01
RACE SLOPE COEFFICIENT	0.18	67.14	243	0.05
SES SLOPE COEFFICIENT	0.26	63.25	243	0.04

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability values.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B7.--Effects of student body characteristics on predictors of grade 3 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	209.43	0.70	299.03**
Percent black	-8.19	0.83	-9.91**
Percent Hispanic	-4.34	0.96	-4.53**
Disadvantaged level	-7.21	1.06	-6.79**
ON GENDER SLOPE COEFFICIENT			
Intercept	-1.23	0.90	-1.37
Percent black	2.13	0.97	2.19*
Percent Hispanic	-0.85	1.25	-0.68
Disadvantaged level	0.73	1.26	0.58
ON RACE SLOPE COEFFICIENT			
Intercept	-14.87	1.55	-9.60**
Percent black	-2.12	2.02	-1.05
Percent Hispanic	0.10	1.70	0.06
Disadvantaged level	2.96	2.09	1.42
ON SES SLOPE COEFFICIENT			
Intercept	11.02	1.00	11.03**
Percent black	0.51	1.22	0.42
Percent Hispanic	-0.01	1.37	-0.01
Disadvantaged level	-2.25	1.25	-1.80

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.77	83.68	240	0.00
GENDER SLOPE COEFFICIENT	0.20	35.63	240	0.01
RACE SLOPE COEFFICIENT	0.16	60.79	240	0.07
SES SLOPE COEFFICIENT	0.26	60.90	240	0.09

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability values.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B8.--Final model for effects of fiscal and physical school characteristics on predictors of grade 3 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	209.27	0.79	265.45**
Percent black	-8.08	0.85	-9.52**
Percent Hispanic	-4.33	0.97	-4.49**
Disadvantaged level	-7.05	1.07	-6.60**
Instructional funds/student	-0.17	0.72	-0.24
Microcomputers/student	0.89	0.71	1.25
Have specialized science lab	0.03	0.52	0.05
Specialized science lab unknown	1.00	2.26	0.44
ON GENDER SLOPE COEFFICIENT			
Intercept	-1.76	0.90	-1.95
Percent black	2.47	1.09	2.27*
Percent Hispanic	-.46	1.24	-0.39
Disadvantaged level	0.69	1.27	0.55
Instructional funds/student	-1.68	1.01	-1.66
Microcomputers/student	0.09	1.38	0.07
Have specialized science lab	0.14	0.62	0.23
Specialized science lab unknown	2.69	3.32	0.81
ON RACE SLOPE COEFFICIENT			
Intercept	-15.12	1.70	-8.91**
Percent black	-2.15	2.04	-1.05
Percent Hispanic	0.15	1.74	0.08
Disadvantaged level	3.10	2.09	1.48
Instructional funds/student	-0.20	1.59	-0.13
Microcomputers/student	1.54	1.49	1.03
Have specialized science lab	-0.96	1.38	-0.70
Specialized science lab unknown	2.42	4.67	0.52
ON SES SLOPE COEFFICIENT			
Intercept	10.95	1.01	10.84**
Percent black	0.59	1.39	0.42
Percent Hispanic	0.00	1.44	0.00
Disadvantaged level	-2.09	1.26	-1.66
Instructional funds/student	-0.64	1.33	-0.48
Microcomputers/student	0.97	1.00	0.98
Have specialized science lab	-1.05	0.79	-1.33
Specialized science lab unknown	0.90	3.24	0.28

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.77	83.98	236	0.00
GENDER SLOPE COEFFICIENT	0.20	34.74	236	0.01
RACE SLOPE COEFFICIENT	0.16	59.81	236	0.05
SES SLOPE COEFFICIENT	0.25	59.42	236	0.07

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability values.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B9.--Final model for effects of school structure characteristics on predictors of grade 3 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.98	0.76	276.14**
Percent black	-8.46	0.82	-10.30**
Percent Hispanic	-4.43	0.97	-4.59**
Disadvantaged level	-7.42	1.09	-6.78**
Student/teacher ratio	-1.09	0.71	-1.53
School size (number of students)	1.87	0.79	2.37*
Classroom organization:			
Team-taught classes	1.53	0.69	2.23*
Departmental structure	1.35	0.64	2.12*
Classroom organization unknown	2.65	2.25	1.18
ON GENDER SLOPE COEFFICIENT			
Intercept	-1.32	0.91	-1.45
Percent black	1.92	0.99	1.94
Percent Hispanic	-1.11	1.29	-0.86
Disadvantaged level	0.57	1.27	0.45
Student/teacher ratio	-0.50	0.78	-0.64
School size (number of students)	1.43	0.98	1.45
ON RACE SLOPE COEFFICIENT			
Intercept	-14.72	1.65	-8.90**
Percent black	-2.03	2.07	-0.98
Percent Hispanic	-0.19	1.70	-0.11
Disadvantaged level	2.81	2.17	1.29
Student/teacher ratio	-0.50	1.49	-0.33
School size (number of students)	0.89	1.12	0.79
Classroom organization:			
Team-taught classes	-0.16	1.11	-0.14
Departmental structure	-0.96	1.65	-0.58
Classroom organization unknown	-1.40	4.10	-0.34
ON SES SLOPE COEFFICIENT			
Intercept	11.05	0.98	11.25**
Percent black	0.35	1.20	0.29
Percent Hispanic	-0.02	1.35	-0.02
Disadvantaged level	-1.92	1.35	-1.43
Student/teacher ratio	-1.74	1.20	-1.45
School size (number of students)	-0.15	1.29	-0.12
Classroom organization:			
Team-taught classes	0.60	0.87	0.69
Departmental structure	-0.19	1.13	-0.16
Classroom organization unknown	1.36	3.72	0.37

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.75	78.61	235	0.00
GENDER SLOPE COEFFICIENT	0.20	34.73	238	0.01
RACE SLOPE COEFFICIENT	0.16	59.97	235	0.07
SES SLOPE COEFFICIENT	0.25	58.42	235	0.06

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability values.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B10.--Final model for effects of academic standards on predictors of grade 3 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	209.33	0.75	279.23**
Percent black	-8.59	0.87	-9.82**
Percent Hispanic	-4.82	1.02	-4.71**
Disadvantaged level	-7.08	1.08	-6.58**
Rigor of academic standards	-0.39	0.74	-0.53
Rigor unknown	1.95	2.53	0.77
Amount of homework	1.21	0.80	1.52
Teacher control in school	0.63	0.80	0.78
ON GENDER SLOPE COEFFICIENT			
Intercept	-1.42	0.87	-1.64
Percent black	2.66	1.25	2.14*
Percent Hispanic	-0.03	1.51	-0.02
Disadvantaged level	0.51	1.36	0.37
Rigor of academic standards	0.07	0.87	0.08
Rigor unknown	2.11	3.77	0.56
Amount of homework	-1.14	1.05	-1.08
Teacher control in school	-1.05	1.05	-1.00
ON RACE SLOPE COEFFICIENT			
Intercept	-14.75	1.63	-9.03**
Percent black	-1.33	1.99	-0.67
Percent Hispanic	1.03	1.77	0.58
Disadvantaged level	2.97	2.10	1.41
Rigor of academic standards	1.02	1.41	0.72
Rigor unknown	-2.83	10.62	-0.27
Change in academic standards	-2.29	1.29	-1.78
Change unknown	3.48	9.53	0.36
Amount of homework	-0.86	1.43	-0.60
Teacher control in school	0.29	1.20	0.25
ON SES SLOPE COEFFICIENT			
Intercept	10.75	0.96	11.20**
Percent black	0.46	1.44	0.32
Percent Hispanic	-0.19	1.43	-0.13
Disadvantaged level	-2.04	1.33	-1.54
Rigor of academic standards	1.31	1.16	1.13
Rigor unknown	1.27	4.15	0.31
Amount of homework	-1.15	1.14	-1.01
Teacher control in school	0.55	1.00	0.55

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.76	82.86	236	0.00
GENDER SLOPE COEFFICIENT	0.20	35.34	236	0.01
RACE SLOPE COEFFICIENT	0.16	59.14	234	0.05
SES SLOPE COEFFICIENT	0.26	60.64	236	0.06

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability values.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B11.--Final model for effects of principal and teacher characteristics on predictors of grade 3 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	209.42	0.72	292.11**
Percent black	-8.71	1.00	-8.73**
Percent Hispanic	-4.67	1.06	-4.42**
Disadvantaged level	-7.30	1.08	-6.78**
Principal years as principal	0.57	0.85	0.67
Principal years in educational administration	0.13	0.92	0.14
Principal years teaching	0.19	0.70	0.28
Amount of principal time academic	-0.21	0.87	-0.24
Amount of principal time with parents	0.49	0.83	0.59
Percent of teachers in minority groups	0.88	1.03	0.85
ON GENDER SLOPE COEFFICIENT			
Intercept	-1.22	0.94	-1.30
Percent black	2.81	1.22	2.31*
Percent Hispanic	-0.30	1.38	-0.22
Disadvantaged level	0.76	1.24	0.62
Principal years as principal	0.08	1.21	0.07
Principal years in educational administration	-0.14	1.41	-0.10
Amount of principal time with parents	-0.30	0.78	-0.38
Percent teachers in minority groups	-1.17	1.15	-1.01
ON RACE SLOPE COEFFICIENT			
Intercept	-14.89	1.55	-9.60**
Percent black	-1.61	2.03	-0.80
Percent Hispanic	0.46	1.69	0.27
Disadvantaged level	2.96	2.05	1.44
Principal years as principal	-0.22	1.23	-0.18
Principal years in educational administration	-0.78	1.37	-0.57
Amount of principal time with parents	-0.35	1.20	-0.29
Percent teachers in minority groups	-0.72	1.80	-0.40
ON SES SLOPE COEFFICIENT			
Intercept	10.98	1.03	10.69**
Percent black	0.63	1.31	0.49
Percent Hispanic	0.14	1.46	0.09
Disadvantaged level	-2.32	1.26	-1.84
Principal years as principal	0.22	1.10	0.20
Principal years in educational administration	-0.16	1.28	-0.12
Amount of principal time with parents	-0.42	1.26	-0.33
Percent teachers in minority groups	-0.12	1.39	-0.09

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.77	84.86	234	0.00
GENDER SLOPE COEFFICIENT	0.21	36.11	236	0.01
RACE SLOPE COEFFICIENT	0.16	60.54	236	0.06
SES SLOPE COEFFICIENT	0.26	61.80	236	0.06

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability values.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B12.--Average within-school predictors of grade 7 math achievement

Predictor	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
INTERCEPT (AVG. ACHIEVEMENT)	269.66	17.42	15.48**
GENDER SLOPE COEFFICIENT	0.23	1.96	0.12
RACE SLOPE COEFFICIENT	-16.06	2.33	-6.90**
SES SLOPE COEFFICIENT	12.84	1.07	11.96**

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.91	184.67	208	0.00
GENDER SLOPE COEFFICIENT	0.17	20.39	208	0.00
RACE SLOPE COEFFICIENT	0.17	54.03	208	0.00
SES SLOPE COEFFICIENT	0.23	45.49	208	0.08

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq .01$; * probability $\leq .05$.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B13.--Effects of student body characteristics on predictors of grade 7 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	261.54	0.62	420.30**
Percent black	-11.39	0.77	-14.86**
Percent Hispanic	-5.22	0.63	-8.21**
Disadvantaged level	-1.33	0.61	-2.20*
ON GENDER SLOPE COEFFICIENT			
Intercept	1.00	0.85	1.17
Percent black	-0.99	0.98	-1.01
Percent Hispanic	-1.05	0.91	-1.16
Disadvantaged level	-0.36	0.70	-0.52
ON RACE SLOPE COEFFICIENT			
Intercept	-15.13	1.21	-12.53**
Percent black	-0.13	1.80	-0.07
Percent Hispanic	1.18	1.28	0.92
Disadvantaged level	-2.45	1.38	-1.78
ON SES SLOPE COEFFICIENT			
Intercept	12.31	0.80	15.46**
Percent black	-3.65	0.85	-4.29**
Percent Hispanic	-2.06	0.71	-2.89**
Disadvantaged level	-0.70	0.73	-0.96

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.75	54.63	202	0.00
GENDER SLOPE COEFFICIENT	0.18	18.38	202	0.01
RACE SLOPE COEFFICIENT	0.19	54.26	202	0.01
SES SLOPE COEFFICIENT	0.18	26.30	202	0.01

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B14.--Final model for effects of fiscal and physical school characteristics on predictors of grade 7 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	261.79	0.74	353.63**
Percent black	-11.78	0.81	-14.58**
Percent Hispanic	-5.49	0.65	-8.41**
Disadvantaged level	-1.33	0.60	-2.21*
Instructional funds/student	1.72	0.63	2.74**
Microcomputers/student	-0.58	0.70	-0.82
Have general science lab	0.54	0.72	0.75
General science lab unknown	-2.42	2.45	-0.99
Have specialized science lab	0.63	0.61	1.03
Specialized science lab unknown	2.04	2.25	0.91
ON GENDER SLOPE COEFFICIENT			
Intercept	1.24	0.90	1.37
Percent black	-0.87	1.02	-0.86
Percent Hispanic	-0.88	1.00	-0.87
Disadvantaged level	-0.41	0.71	-0.58
Instructional funds/student	-0.07	0.72	-0.09
Microcomputers/student	0.49	0.85	0.58
Have specialized science lab	0.59	0.68	0.86
Specialized science lab unknown	-1.09	1.61	-0.68
ON RACE SLOPE COEFFICIENT			
Intercept	-14.87	1.51	-9.83**
Percent black	0.05	1.91	0.03
Percent Hispanic	0.90	1.41	0.64
Disadvantaged level	-2.35	1.40	-1.68
Instructional funds/student	0.46	1.19	0.38
Microcomputers/student	0.04	1.65	0.02
Have specialized science lab	-1.02	1.13	-0.90
Specialized science lab unknown	-0.42	2.58	-0.16
ON SES SLOPE COEFFICIENT			
Intercept	12.49	0.96	13.00**
Percent black	-3.85	0.91	-4.21**
Percent Hispanic	-2.23	0.71	-3.14**
Disadvantaged level	-0.67	0.73	-0.92
Instructional funds/student	0.50	0.92	0.54
Microcomputers/student	-0.17	0.92	-0.18
Have specialized science lab	-0.27	0.80	-0.34
Specialized science lab unknown	-0.09	1.63	-0.05

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.75	52.88	196	0.00
GENDER SLOPE COEFFICIENT	0.18	18.34	198	0.01
RACE SLOPE COEFFICIENT	0.20	57.03	198	0.01
SES SLOPE COEFFICIENT	0.19	26.75	198	0.01

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B15.--Final model for effects of school structure characteristics on predictors of grade 7 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	261.33	0.68	383.71**
Percent black	-11.05	0.76	-14.58**
Percent Hispanic	-5.59	0.64	-8.78**
Disadvantaged level	-1.53	0.64	-2.40*
Math tracking	1.51	0.68	2.23*
Math tracking unknown	-1.70	1.89	-0.90
Student/teacher ratio	-1.14	0.66	-1.72
School size (number of students)	1.05	0.65	1.63
ON GENDER SLOPE COEFFICIENT			
Intercept	0.93	0.90	1.03
Percent black	-0.97	0.97	-1.01
Percent Hispanic	-1.07	0.93	-1.15
Disadvantaged level	-0.56	0.74	-0.75
Student/teacher ratio	-0.94	0.78	-1.21
School size (number of students)	0.49	0.91	0.54
ON RACE SLOPE COEFFICIENT			
Intercept	-15.22	1.38	-11.02**
Percent black	-0.23	1.85	-0.13
Percent Hispanic	1.23	1.27	0.96
Disadvantaged level	-2.70	1.38	-1.96*
Student/teacher ratio	-0.57	1.42	-0.40
School size (number of students)	-0.10	1.28	-0.08
Classroom organization:			
Self-contained classrooms	2.43	1.50	1.63
Team-taught classes	-1.77	1.11	-1.59
Classroom organization unknown	3.19	3.34	0.96
ON SES SLOPE COEFFICIENT			
Intercept	12.39	0.88	14.04**
Percent black	-3.74	0.87	-4.33**
Percent Hispanic	-2.19	0.77	-2.82**
Disadvantaged level	-0.95	0.76	-1.25
Student/teacher ratio	-1.31	0.83	-1.59
School size (number of students)	0.75	1.36	0.55
Classroom organization:			
Self-contained classrooms	0.63	1.44	0.43
Team-taught classes	-0.73	1.28	-0.57
Classroom organization unknown	-0.79	2.29	-0.35

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG ACHIEVEMENT)	0.74	51.28	198	0.00
GENDER SLOPE COEFFICIENT	0.18	17.95	200	0.01
RACE SLOPE COEFFICIENT	0.19	53.58	197	0.00
SES SLOPE COEFFICIENT	0.18	25.59	197	0.01

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B16.--Final model for effects of academic standards on predictors of grade 7 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	262.05	0.64	412.57**
Percent black	-11.34	0.78	-14.59**
Percent Hispanic	-4.73	0.63	-7.49**
Disadvantaged level	-1.18	0.60	-1.96
Rigor of academic standards	-0.83	0.65	-1.26
Rigor unknown	15.46	8.27	1.87
Change in academic standards	-1.91	0.74	-2.57*
Change unknown	-15.81	8.05	-1.96*
Amount of homework	1.86	0.66	2.81**
Teacher control in school	-0.04	0.74	-0.06
ON GENDER SLOPE COEFFICIENT			
Intercept	1.12	0.88	1.27
Percent black	-0.86	1.06	-0.81
Percent Hispanic	-0.91	0.93	-0.98
Disadvantaged level	-0.43	0.71	-0.61
Amount of homework	1.07	0.72	1.47
Teacher control in school	0.73	0.90	0.81
ON RACE SLOPE COEFFICIENT			
Intercept	-15.27	1.23	-12.39**
Percent black	0.35	1.90	0.18
Percent Hispanic	1.22	1.29	0.94
Disadvantaged level	-2.33	1.37	-1.69
Amount of homework	-0.98	1.24	-0.79
Teacher control in school	0.73	1.67	0.44
ON SES SLOPE COEFFICIENT			
Intercept	12.48	0.86	14.55**
Percent black	-3.70	0.95	-3.88**
Percent Hispanic	-1.90	0.78	-2.43*
Disadvantaged level	-0.53	0.79	-0.66
Rigor of academic standards	0.04	0.76	0.05
Rigor unknown	5.72	9.21	0.62
Change in academic standards	-0.79	0.93	-0.85
Change unknown	-6.61	9.33	-0.71
Amount of homework	0.02	0.84	0.03
Teacher control in school	-0.30	0.93	-0.32

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.73	47.82	196	0.00
GENDER SLOPE COEFFICIENT	0.18	17.95	200	0.01
RACE SLOPE COEFFICIENT	0.19	56.52	200	0.01
SES SLOPE COEFFICIENT	0.19	26.96	196	0.01

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[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B17.--Final model for effects of principal and teacher characteristics on predictors of grade 7 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	261.47	0.63	415.00**
Percent black	-10.55	1.15	-9.17**
Percent Hispanic	-5.04	0.68	-7.45**
Disadvantaged level	-1.27	0.61	-2.08*
Amount of principal time with parents	0.19	0.66	0.28
Percent teachers in minority groups	-1.16	1.07	-1.08
Amount of teacher time academic	-0.97	0.74	-1.31
Amount of parent/teacher time	0.65	0.67	0.98
ON GENDER SLOPE COEFFICIENT			
Intercept	1.08	0.86	1.25
Percent black	-0.51	1.27	-0.40
Percent Hispanic	-0.88	0.93	-0.95
Disadvantaged level	-0.36	0.70	-0.51
Principal years teaching	0.78	0.74	1.06
Amount of principal time with parents	-0.20	0.80	-0.25
Percent teachers in minority groups	-0.89	1.09	-0.81
Amount of teacher time academic	1.28	0.76	1.68
Amount of parent/teacher time	-0.77	0.67	-1.14
ON RACE SLOPE COEFFICIENT			
Intercept	-14.98	1.25	-11.96**
Percent black	1.43	2.61	0.55
Percent Hispanic	1.47	1.37	1.07
Disadvantaged level	-2.63	1.38	-1.91
Principal years teaching	-0.04	1.06	-0.04
Amount of principal time with parents	0.31	1.14	0.27
Percent teachers in minority groups	-1.78	2.14	-0.83
Amount of teacher time academic	1.20	1.39	0.86
Amount of parent/teacher time	-1.35	1.27	-1.06
ON SES SLOPE COEFFICIENT			
Intercept	12.38	0.79	15.58**
Percent black	-2.54	1.23	-2.06*
Percent Hispanic	-1.80	0.73	-2.45*
Disadvantaged level	-0.68	0.72	-0.94
Amount of principal time with parents	-0.23	0.70	-0.33
Percent teachers in minority groups	-1.50	1.16	-1.30
Amount of teacher time academic	0.79	0.92	0.86
Amount of parent/teacher time	-0.58	0.78	-0.74

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.75	54.97	198	0.00
GENDER SLOPE COEFFICIENT	0.18	18.09	197	0.02
RACE SLOPE COEFFICIENT	0.20	57.91	197	0.00
SES SLOPE COEFFICIENT	0.18	25.70	198	0.01

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B18.--Average within-school predictors of grade 11 math achievement

Predictor	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
INTERCEPT (AVG. ACHIEVEMENT)	298.03	0.99	300.91**
GENDER SLOPE COEFFICIENT	-2.78	0.75	-3.73**
RACE SLOPE COEFFICIENT	-19.32	1.19	-16.21**
SES SLOPE COEFFICIENT	14.27	1.01	14.08**

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.89	211.65	223	0.00
GENDER SLOPE COEFFICIENT	0.13	27.49	223	>0.50
RACE SLOPE COEFFICIENT	0.12	55.41	223	0.32
SES SLOPE COEFFICIENT	0.13	72.90	223	0.26

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B19.--Effects of student body characteristics on predictors of grade 11 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	298.96	0.75	399.90**
Percent black	-8.84	0.83	-10.59**
Percent Hispanic	-4.99	0.75	-6.62**
Disadvantaged level	-1.84	0.77	-2.40*
ON GENDER SLOPE COEFFICIENT			
Intercept	-2.90	0.80	-3.63**
Percent black	-0.18	1.01	-0.18
Percent Hispanic	-0.96	0.96	-1.00
Disadvantaged level	-1.05	1.05	-1.00
ON RACE SLOPE COEFFICIENT			
Intercept	-19.42	1.20	-16.23**
Percent black	-0.72	1.60	-0.45
Percent Hispanic	0.67	1.25	0.54
Disadvantaged level	2.41	1.58	1.52
ON SES SLOPE COEFFICIENT			
Intercept	14.41	0.99	14.51**
Percent black	-1.61	1.06	-1.52
Percent Hispanic	-2.75	1.03	-2.68**
Disadvantaged level	-0.84	1.00	-0.84

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.80	99.22	220	0.00
GENDER SLOPE COEFFICIENT	0.16	34.55	220	>0.50
RACE SLOPE COEFFICIENT	0.12	53.37	220	0.48
SES SLOPE COEFFICIENT	0.12	66.03	220	0.39

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B20.--Final model for effects of fiscal and physical school characteristics on predictors of grade 11 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	300.01	0.81	370.41**
Percent black	-9.20	0.81	-11.29**
Percent Hispanic	-5.24	0.73	-7.21**
Disadvantaged level	-1.64	0.76	-2.17*
Instructional funds/student	2.10	0.76	2.76**
Microcomputers/student	0.36	0.84	0.43
Have general science lab	-1.65	0.85	-1.94
General science lab unknown	-3.65	3.28	-1.11
Have specialized science lab	3.83	0.90	4.25**
Specialized science lab unknown	-2.71	3.79	-0.72
ON GENDER SLOPE COEFFICIENT			
Intercept	-2.93	0.94	-3.11**
Percent black	-0.24	1.00	-0.24
Percent Hispanic	-0.91	0.97	-0.94
Disadvantaged level	-1.09	1.08	-1.01
Instructional funds/student	0.02	0.86	0.02
Microcomputers/student	-0.35	1.12	-0.31
Have specialized science lab	-0.90	1.28	-0.70
Specialized science lab unknown	0.73	3.02	0.24
ON RACE SLOPE COEFFICIENT			
Intercept	-18.64	1.33	-14.00**
Percent black	-0.82	1.61	-0.51
Percent Hispanic	0.84	1.25	0.67
Disadvantaged level	2.66	1.57	1.69
Instructional funds/student	0.65	1.52	0.43
Microcomputers/student	-0.43	1.66	-0.26
Have specialized science lab	0.06	1.56	0.04
Specialized science lab unknown	-8.74	4.10	-2.13*
ON SES SLOPE COEFFICIENT			
Intercept	14.31	1.18	12.16**
Percent black	-1.59	1.08	-1.47
Percent Hispanic	-2.98	1.06	-2.82**
Disadvantaged level	-1.08	1.04	-1.03
Instructional funds/student	0.45	1.08	0.42
Microcomputers/student	1.03	1.24	0.83
Have specialized science lab	0.06	1.32	0.05
Specialized science lab unknown	3.18	3.17	1.00

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.77	84.81	214	0.00
GENDER SLOPE COEFFICIENT	0.17	35.06	216	>0.50
RACE SLOPE COEFFICIENT	0.11	51.81	216	0.39
SES SLOPE COEFFICIENT	0.12	66.02	216	0.33

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B21.--Final model for effects of school structure characteristics on predictors of grade 11 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	298.74	0.77	386.99**
Percent black	-9.21	0.80	-11.57**
Percent Hispanic	-5.36	0.74	-7.21**
Disadvantaged level	-2.11	0.75	-2.82**
Science tracking	1.75	0.72	2.44*
Science tracking unknown	-5.49	2.36	-2.33*
Student/teacher ratio	0.34	0.91	0.38
School size (number of students)	3.62	0.76	4.76**
ON GENDER SLOPE COEFFICIENT			
Intercept	-2.63	0.89	-2.96**
Percent black	-0.15	1.02	-0.14
Percent Hispanic	-1.09	1.02	-1.07
Disadvantaged level	-0.76	1.06	-0.72
Math tracking	0.97	0.85	1.14
Math tracking unknown	1.85	2.96	0.63
Student/teacher ratio	1.23	1.26	0.98
School size (number of students)	-2.13	0.98	-2.18*
ON RACE SLOPE COEFFICIENT			
Intercept	-19.63	1.34	-14.59**
Percent black	-0.60	1.61	-0.37
Percent Hispanic	0.75	1.29	0.58
Disadvantaged level	2.28	1.67	1.37
Student/teacher ratio	-0.59	1.67	-0.35
School size (number of students)	0.65	1.66	0.39
ON SES SLOPE COEFFICIENT			
Intercept	14.39	1.07	13.50**
Percent black	-1.43	1.06	-1.35
Percent Hispanic	-2.31	1.04	-2.22*
Disadvantaged level	-0.83	1.00	-0.83
Student/teacher ratio	-1.98	1.53	-1.29
School size (number of students)	-0.91	1.09	-0.84

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.77	84.59	216	0.00
GENDER SLOPE COEFFICIENT	0.16	34.34	216	>0.50
RACE SLOPE COEFFICIENT	0.12	53.51	218	0.43
SES SLOPE COEFFICIENT	0.12	63.86	218	0.41

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B22.--Final model for effects of academic standards on predictors of grade 11 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	298.78	0.72	415.31**
Percent black	-8.85	0.82	-10.75**
Percent Hispanic	-4.98	0.73	-6.85**
Disadvantaged level	-1.83	0.74	-2.46*
Amount of homework	4.14	0.85	4.86**
Teacher control in school	0.17	0.81	0.21
ON GENDER SLOPE COEFFICIENT			
Intercept	-2.58	0.81	-3.19**
Percent black	0.28	1.04	0.27
Percent Hispanic	-0.93	0.95	-0.98
Disadvantaged level	-0.80	1.04	-0.76
Amount of homework	-1.34	1.08	-1.25
Teacher control in school	1.60	0.96	1.66
ON RACE SLOPE COEFFICIENT			
Intercept	-18.29	1.25	-14.60**
Percent black	-2.01	1.71	-1.18
Percent Hispanic	0.38	1.36	0.28
Disadvantaged level	3.09	1.64	1.88
Rigor of academic standards	-0.94	1.53	-0.62
Rigor unknown	1.95	20.39	0.10
Change in academic standards	2.57	1.38	1.86
Change unknown	-13.26	20.30	-0.65
Amount of homework	-1.53	1.74	-0.88
Teacher control in school	-2.36	1.44	-1.64
ON SES SLOPE COEFFICIENT			
Intercept	14.41	1.07	13.42**
Percent black	-1.48	1.13	-1.31
Percent Hispanic	-2.58	1.06	-2.42*
Disadvantaged level	-0.91	1.09	-0.84
Rigor of academic standards	-0.56	1.16	-0.48
Rigor unknown	0.63	8.20	0.08
Change in academic standards	0.16	1.08	0.15
Change unknown	0.74	7.34	0.10
Amount of homework	-0.80	1.35	-0.59
Teacher control in school	0.35	1.18	0.30

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.78	88.23	218	0.00
GENDER SLOPE COEFFICIENT	0.16	33.46	218	>0.50
RACE SLOPE COEFFICIENT	0.10	47.18	214	>0.50
SES SLOPE COEFFICIENT	0.12	66.83	214	0.32

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[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B23.--Final model for effects of principal and teacher characteristics on predictors of grade 11 math achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	298.81	0.75	398.32**
Percent black	-7.47	1.16	-6.45**
Percent Hispanic	-4.46	0.87	-5.12**
Disadvantaged level	-2.09	0.78	-2.68**
Amount of principal time with parents	1.05	0.75	1.40
Percent teachers in minority groups	-1.70	1.15	-1.47
Amount of teacher time academic	0.22	0.94	0.24
Amount of parent/teacher time	-0.94	0.85	-1.11
ON GENDER SLOPE COEFFICIENT			
Intercept	-2.87	0.81	-3.55**
Percent black	-0.39	1.42	-0.27
Percent Hispanic	-1.06	1.06	-1.00
Disadvantaged level	-0.89	1.06	-0.83
Principal years teaching	1.13	0.88	1.28
Amount of principal time with parents	0.17	0.81	0.20
Percent teachers in minority groups	-0.16	1.37	-0.12
Amount of teacher time academic	-1.27	1.14	-1.11
Amount of parent/teacher time	1.25	0.97	1.28
ON RACE SLOPE COEFFICIENT			
Intercept	-19.54	1.19	-16.39**
Percent black	-0.82	2.28	-0.36
Percent Hispanic	0.51	1.46	0.35
Disadvantaged level	1.54	1.70	0.90
Principal years teaching	1.52	1.26	1.21
Amount of principal time with parents	-2.31	1.21	-1.91
Percent teachers in minority groups	0.04	2.32	0.02
Amount of teacher time academic	-3.95	1.58	-2.50*
Amount of parent/teacher time	-2.11	1.50	-1.41
ON SES SLOPE COEFFICIENT			
Intercept	14.24	1.03	13.79**
Percent black	-0.96	1.47	-0.65
Percent Hispanic	-2.42	1.13	-2.14*
Disadvantaged level	-0.92	1.02	-0.90
Amount of principal time with parents	-0.38	1.03	-0.37
Percent teachers in minority groups	-0.75	1.51	-0.49
Amount of teacher time academic	0.70	1.66	0.42
Amount of parent/teacher time	-0.52	1.25	-0.41

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.79	98.08	216	0.00
GENDER SLOPE COEFFICIENT	0.16	33.30	215	>.50
RACE SLOPE COEFFICIENT	0.09	39.24	215	0.43
SES SLOPE COEFFICIENT	0.12	65.88	216	0.29

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

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Table B24.--Average within-school predictors of grade 3 science achievement

Predictor	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
INTERCEPT (AVG. ACHIEVEMENT)	207.07	1.45	143.05**
GENDER SLOPE COEFFICIENT	-0.51	1.06	-0.48
RACE SLOPE COEFFICIENT	-17.89	1.44	-12.43**
SES SLOPE COEFFICIENT	14.14	1.17	12.04**

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.93	451.83	247	0.00
GENDER SLOPE COEFFICIENT	0.26	67.78	247	0.00
RACE SLOPE COEFFICIENT	0.26	134.54	247	0.01
SES SLOPE COEFFICIENT	0.31	114.53	247	0.00

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B25.--Effects of student body characteristics on predictors of grade 3 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.08	0.94	221.94**
Percent black	-11.10	1.01	-10.98**
Percent Hispanic	-6.09	1.11	-5.50**
Disadvantaged level	-10.24	1.29	-7.95**
ON GENDER SLOPE COEFFICIENT			
Intercept	-0.74	1.07	-0.69
Percent black	0.93	1.18	0.79
Percent Hispanic	-0.66	1.35	-0.49
Disadvantaged level	2.33	1.86	1.26
ON RACE SLOPE COEFFICIENT			
Intercept	-18.11	1.46	-12.43**
Percent black	-1.14	2.04	-0.56
Percent Hispanic	1.22	1.87	0.65
Disadvantaged level	2.00	2.05	0.97
ON SES SLOPE COEFFICIENT			
Intercept	14.31	1.17	12.24**
Percent black	-0.92	1.44	-0.64
Percent Hispanic	-1.25	1.69	-0.74
Disadvantaged level	-3.64	1.59	-2.28*

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.79	130.94	244	0.00
GENDER SLOPE COEFFICIENT	0.25	62.44	244	0.00
RACE SLOPE COEFFICIENT	0.26	130.76	244	0.02
SES SLOPE COEFFICIENT	0.28	98.34	244	0.00

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B26.--Final model for effects of fiscal and physical school characteristics on predictors of grade 3 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.05	0.98	212.70**
Percent black	-10.82	1.04	-10.43**
Percent Hispanic	-5.68	1.14	-5.00**
Disadvantaged level	-10.26	1.28	-8.00**
Instructional funds/student	-1.00	0.87	-1.15
Microcomputers/student	1.29	0.85	1.51
Have general science lab	1.09	0.95	1.15
General science lab unknown	-9.36	9.66	-0.97
Have specialized science lab	0.18	0.63	0.29
Specialized science lab unknown	6.62	9.24	0.72
ON GENDER SLOPE COEFFICIENT			
Intercept	-0.50	1.18	-0.43
Percent black	1.65	1.27	1.30
Percent Hispanic	-0.35	1.40	-0.25
Disadvantaged level	2.28	1.82	1.25
Instructional funds/student	-1.90	1.02	-1.86
Microcomputers/student	0.94	0.99	0.96
Have specialized science lab	-0.52	1.14	-0.45
Specialized science lab unknown	-3.68	3.02	-1.22
ON RACE SLOPE COEFFICIENT			
Intercept	-17.93	1.58	-11.32**
Percent black	-1.30	2.11	-0.62
Percent Hispanic	1.02	1.97	0.52
Disadvantaged level	1.99	2.07	0.97
Instructional funds/student	0.13	1.50	0.09
Microcomputers/student	-0.26	1.70	-0.15
Have specialized science lab	-1.89	1.87	-1.01
Specialized science lab unknown	-1.01	4.79	-0.21
ON SES SLOPE COEFFICIENT			
Intercept	14.60	1.20	12.16**
Percent black	-1.27	1.49	-0.85
Percent Hispanic	-1.60	1.68	-0.95
Disadvantaged level	-3.66	1.57	-2.33*
Instructional funds/student	1.05	1.18	0.90
Microcomputers/student	-0.11	1.40	-0.08
Have specialized science lab	-1.73	1.16	-1.49
Specialized science lab unknown	-0.12	3.88	-0.03

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.79	127.51	238	0.00
GENDER SLOPE COEFFICIENT	0.24	58.19	240	0.00
RACE SLOPE COEFFICIENT	0.26	130.85	240	0.01
SES SLOPE COEFFICIENT	0.28	96.80	240	0.00

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[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

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Table B27.--Final model for effects of school structure characteristics on predictors of grade 3 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.05	0.95	220.05**
Percent black	-11.26	0.99	-11.43**
Percent Hispanic	-6.08	1.10	-5.53**
Disadvantaged level	-10.71	1.27	-8.42**
Student/teacher ratio	-2.07	0.85	-2.45*
School size (number of students)	2.38	0.99	2.40*
Classroom organization:			
Team-taught classes	2.06	0.84	2.45*
Departmental structure	1.68	0.79	2.12*
Classroom organization unknown	-0.37	2.58	-0.14
ON GENDER SLOPE COEFFICIENT			
Intercept	-0.69	1.04	-0.66
Percent black	0.72	1.18	0.62
Percent Hispanic	-0.71	1.35	-0.52
Disadvantaged level	2.32	1.84	1.26
Student/teacher ratio	-2.13	1.02	-2.09*
School size (number of students)	1.12	1.02	1.09
ON RACE SLOPE COEFFICIENT			
Intercept	-18.02	1.67	-10.76**
Percent black	-1.16	2.10	-0.55
Percent Hispanic	1.05	1.91	0.55
Disadvantaged level	1.51	2.16	0.70
Student/teacher ratio	-0.12	1.79	-0.07
School size (number of students)	1.34	1.70	0.79
Classroom organization:			
Team-taught classes	-0.87	1.68	-0.52
Departmental structure	-0.56	1.82	-0.31
Classroom organization unknown	-2.10	4.57	-0.46
ON SES SLOPE COEFFICIENT			
Intercept	14.76	1.20	12.26**
Percent black	-1.03	1.46	-0.70
Percent Hispanic	-1.64	1.73	-0.95
Disadvantaged level	-3.58	1.62	-2.21*
Student/teacher ratio	-1.26	1.02	-1.24
School size (number of students)	0.47	1.16	0.41
Classroom organization:			
Team-taught classes	0.27	1.24	0.21
Departmental structure	-1.65	1.12	-1.47
Classroom organization unknown	-1.67	3.89	-0.43

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.78	120.43	239	0.00
GENDER SLOPE COEFFICIENT	0.24	59.72	242	0.00
RACE SLOPE COEFFICIENT	0.26	130.06	239	0.01
SES SLOPE COEFFICIENT	0.28	98.59	239	0.00

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B28.--Final model for effects of academic standards on predictors of grade 3 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.48	0.99	211.30**
Percent black	-11.09	1.09	-10.17**
Percent Hispanic	-6.11	1.19	-5.15**
Disadvantaged level	-10.46	1.31	-7.99**
Rigor of academic standards	-0.57	1.00	-0.57
Rigor unknown	-5.24	10.46	-0.50
Change in academic standards	0.12	0.99	0.12
Change unknown	1.42	10.04	0.14
Amount of homework	0.70	1.02	0.69
ON GENDER SLOPE COEFFICIENT			
Intercept	-0.84	1.21	-0.70
Percent black	1.11	1.35	0.82
Percent Hispanic	-0.68	1.53	-0.45
Disadvantaged level	2.20	1.91	1.15
Rigor of academic standards	0.90	1.04	0.86
Rigor unknown	-13.29	10.35	-1.28
Change in academic standards	1.16	1.13	1.02
Change unknown	12.31	10.48	1.17
Amount of homework	-1.78	1.19	-1.49
ON RACE SLOPE COEFFICIENT			
Intercept	-18.07	1.53	-11.82**
Percent black	-1.02	2.24	-0.46
Percent Hispanic	1.56	2.05	0.76
Disadvantaged level	2.11	2.08	1.02
Rigor of academic standards	0.30	1.56	0.19
Rigor unknown	-23.10	15.76	-1.47
Change in academic standards	-1.66	1.46	-1.14
Change unknown	21.83	14.64	1.49
Amount of homework	1.10	1.67	0.65
ON SES SLOPE COEFFICIENT			
Intercept	14.39	1.20	12.03**
Percent black	-1.31	1.44	-0.91
Percent Hispanic	-1.65	1.70	-0.97
Disadvantaged level	-3.53	1.62	-2.17*
Rigor of academic standards	0.18	1.51	0.12
Rigor unknown	-0.02	4.01	0.00
Amount of homework	1.00	1.24	0.81

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.80	132.73	239	0.00
GENDER SLOPE COEFFICIENT	0.25	61.63	239	0.00
RACE SLOPE COEFFICIENT	0.26	128.38	239	0.02
SES SLOPE COEFFICIENT	0.28	99.22	241	0.00

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability .≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B29.--Final model for effects of principal and teacher characteristics on predictors of grade 3 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	208.06	0.97	213.68**
Percent black	-11.24	1.26	-8.89**
Percent Hispanic	-6.11	1.26	-4.86**
Disadvantaged level	-10.23	1.30	-7.88**
Principal years as principal	0.63	1.00	0.63
Principal years in educational administration	-0.40	1.21	-0.33
Principal years teaching	0.08	0.86	0.10
Amount of principal time academic	0.48	1.11	0.44
Amount of principal time with parents	0.47	1.05	0.45
Percent teachers in minority groups	0.03	1.23	0.02
ON GENDER SLOPE COEFFICIENT			
Intercept	-0.87	1.11	-0.78
Percent black	1.30	1.44	0.90
Percent Hispanic	-0.17	1.52	-0.11
Disadvantaged level	2.15	1.79	1.20
Principal years as principal	1.01	1.24	0.81
Principal years in educational administration	-1.56	1.40	-1.11
Amount of principal time with parents	-0.69	1.05	-0.65
Percent teachers in minority groups	-0.47	1.46	-0.32
ON RACE SLOPE COEFFICIENT			
Intercept	-18.09	1.49	-12.10**
Percent black	-1.45	2.40	-0.60
Percent Hispanic	0.86	2.22	0.39
Disadvantaged level	2.15	2.09	1.03
Principal years as principal	-0.57	1.89	-0.30
Principal years in educational administration	0.90	2.45	0.37
Amount of principal time with parents	1.15	1.68	0.68
Percent teachers in minority groups	0.33	2.06	0.16
ON SES SLOPE COEFFICIENT			
Intercept	14.42	1.14	12.60**
Percent black	-0.56	1.68	-0.33
Percent Hispanic	-1.02	1.80	-0.57
Disadvantaged level	-3.62	1.61	-2.25*
Principal years as principal	0.22	1.39	0.16
Principal years in educational administration	0.88	1.58	0.56
Amount of principal time with parents	-0.39	1.15	-0.34
Percent teachers in minority groups	-0.50	1.56	-0.32

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.80	133.36	238	0.00
GENDER SLOPE COEFFICIENT	0.25	61.72	240	0.00
RACE SLOPE COEFFICIENT	0.26	130.84	240	0.01
SES SLOPE COEFFICIENT	0.28	99.75	240	0.00

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B30.--Average within-school predictors of grade 7 science achievement

Predictor	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
INTERCEPT (AVG. ACHIEVEMENT)	242.11	1.35	179.84**
GENDER SLOPE COEFFICIENT	-6.24	0.83	-7.54**
RACE SLOPE COEFFICIENT	-22.32	1.43	-15.64**
SES SLOPE COEFFICIENT	18.33	0.98	18.66**

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.94	372.57	206	0.00
GENDER SLOPE COEFFICIENT	0.18	30.41	206	0.00
RACE SLOPE COEFFICIENT	0.08	45.94	206	0.00
SES SLOPE COEFFICIENT	0.08	53.61	206	0.00

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B31.--Effects of student body characteristics on predictors of grade 7 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	240.07	0.72	333.48**
Percent black	-16.87	0.90	-18.81**
Percent Hispanic	-9.16	0.76	-12.02**
Disadvantaged level	-2.36	0.71	-3.33**
ON GENDER SLOPE COEFFICIENT			
Intercept	-6.21	0.94	-6.62**
Percent black	-1.21	1.23	-0.99
Percent Hispanic	-0.19	1.16	-0.17
Disadvantaged level	0.11	0.93	0.11
ON RACE SLOPE COEFFICIENT			
Intercept	-22.21	1.40	-15.86**
Percent black	0.42	2.19	0.19
Percent Hispanic	0.88	1.52	0.58
Disadvantaged level	-0.04	1.54	-0.03
ON SES SLOPE COEFFICIENT			
Intercept	17.91	0.90	19.88**
Percent black	-3.96	0.99	-3.99**
Percent Hispanic	-3.22	0.96	-3.36**
Disadvantaged level	-1.05	0.82	-1.28

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.75	74.30	203	0.00
GENDER SLOPE COEFFICIENT	0.22	35.77	203	0.00
RACE SLOPE COEFFICIENT	0.12	72.90	203	0.00
SES SLOPE COEFFICIENT	0.04	28.77	203	0.00

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[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B32.--Final model for effects of fiscal and physical school characteristics on predictors of grade 7 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	240.36	0.90	267.28**
Percent black	-16.78	0.94	-17.82**
Percent Hispanic	-9.07	0.80	-11.33**
Disadvantaged level	-2.33	0.71	-3.27**
Instructional funds/student	0.65	0.74	0.88
Microcomputers/student	-0.11	0.84	-0.13
Have general science lab	0.69	0.82	0.83
General science lab unknown	-4.30	2.98	-1.44
Have specialized science lab	0.64	0.72	0.89
Specialized science lab unknown	1.96	2.53	0.78
ON GENDER SLOPE COEFFICIENT			
Intercept	-5.01	1.03	-4.84**
Percent black	-1.46	1.25	-1.17
Percent Hispanic	-0.30	1.20	-0.25
Disadvantaged level	0.15	0.94	0.16
Instructional funds/student	0.80	0.87	0.91
Microcomputers/student	0.07	1.09	0.06
Have specialized science lab	-0.29	0.86	-0.33
Specialized science lab unknown	-4.55	2.07	-2.20*
ON RACE SLOPE COEFFICIENT			
Intercept	-22.74	1.57	-14.49**
Percent black	0.12	2.29	0.05
Percent Hispanic	0.86	1.65	0.52
Disadvantaged level	-0.12	1.54	-0.08
Instructional funds/student	-0.11	1.39	-0.08
Microcomputers/student	-0.90	1.78	-0.50
Have specialized science lab	-0.08	1.35	-0.06
Specialized science lab unknown	1.62	2.86	0.56
ON SES SLOPE COEFFICIENT			
Intercept	17.89	1.11	16.15**
Percent black	-3.88	1.07	-3.62**
Percent Hispanic	-3.24	0.98	-3.30**
Disadvantaged level	-1.02	0.81	-1.26
Instructional funds/student	0.20	0.78	0.26
Microcomputers/student	0.69	0.99	0.70
Have specialized science lab	0.48	0.89	0.54
Specialized science lab unknown	0.49	2.18	0.22

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.75	75.23	197	0.00
GENDER SLOPE COEFFICIENT	0.21	33.95	199	0.00
RACE SLOPE COEFFICIENT	0.12	74.17	199	0.00
SES SLOPE COEFFICIENT	0.04	28.66	199	0.00

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] arameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B33.--Final model for effects of school structure characteristics on predictors of grade 7 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	240.39	0.79	305.14**
Percent black	-16.42	0.89	-18.45**
Percent Hispanic	-9.35	0.78	-11.98**
Disadvantaged level	-2.37	0.73	-3.23**
Math tracking	1.65	0.81	2.03*
Math tracking unknown	-5.17	2.12	-2.44*
Student/teacher ratio	-0.92	0.76	-1.20
School size (number of students)	0.72	0.75	0.96
ON GENDER SLOPE COEFFICIENT			
Intercept	-6.15	0.98	-6.25**
Percent black	-1.26	1.23	-1.02
Percent Hispanic	-0.06	1.22	-0.05
Disadvantaged level	0.17	0.94	0.19
Student/teacher ratio	-0.58	0.88	-0.66
School size (number of students)	-0.37	0.94	-0.39
ON RACE SLOPE COEFFICIENT			
Intercept	-22.30	1.52	-14.71**
Percent black	0.26	2.27	0.12
Percent Hispanic	0.87	1.56	0.56
Disadvantaged level	0.04	1.61	0.02
Student/teacher ratio	0.15	1.44	0.10
School size (number of students)	-0.08	1.45	-0.06
Classroom organization:			
Self-contained classrooms	1.47	1.53	0.96
Classroom organization unknown	1.57	4.13	0.38
ON SES SLOPE COEFFICIENT			
Intercept	17.95	0.95	18.93**
Percent black	-3.97	1.02	-3.90**
Percent Hispanic	-3.21	0.98	-3.27**
Disadvantaged level	-0.96	0.86	-1.11
Student/teacher ratio	0.28	1.15	0.24
School size (number of students)	-0.23	1.17	-0.20
Classroom organization:			
Self-contained classrooms	-0.53	1.24	-0.43
Classroom organization unknown	-0.28	2.23	-0.13

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.74	70.01	199	0.00
GENDER SLOPE COEFFICIENT	0.22	36.14	201	0.00
RACE SLOPE COEFFICIENT	0.12	74.81	199	0.00
SES SLOPE COEFFICIENT	0.04	28.96	199	0.00

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B34.--Final model for effects of academic standards on predictors of grade 7 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	241.04	0.76	315.25**
Percent black	-16.32	0.91	-17.95**
Percent Hispanic	-8.47	0.75	-11.27**
Disadvantaged level	-1.87	0.69	-2.69**
Change in academic standards	-2.36	0.76	-3.10**
Change unknown	-5.25	2.10	-2.50*
Amount of homework	1.12	0.94	1.20
Teacher control in school	0.75	0.82	0.91
ON GENDER SLOPE COEFFICIENT			
Intercept	-5.97	0.92	-6.48**
Percent black	-1.27	1.29	-0.98
Percent Hispanic	-0.06	1.17	-0.05
Disadvantaged level	-0.11	0.93	-0.12
Amount of homework	1.55	0.87	1.77
Teacher control in school	0.22	0.99	0.22
ON RACE SLOPE COEFFICIENT			
Intercept	-22.42	1.45	-15.48**
Percent black	0.62	2.28	0.27
Percent Hispanic	0.86	1.52	0.56
Disadvantaged level	0.16	1.52	0.10
Amount of homework	-1.16	1.34	-0.87
Teacher control in school	0.49	1.57	0.32
ON SES SLOPE COEFFICIENT			
Intercept	17.94	0.94	19.07**
Percent black	-3.46	1.11	-3.12**
Percent Hispanic	-2.97	0.97	-3.06**
Disadvantaged level	-0.41	0.89	-0.46
Rigor of academic standards	1.45	1.02	1.42
Rigor unknown	-2.59	11.18	-0.23
Change in academic standards	-1.30	0.84	-1.55
Change unknown	1.74	11.08	0.16
Amount of homework	-0.90	1.01	-0.90
Teacher control in school	1.22	1.13	1.08

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.73	67.20	199	0.00
GENDER SLOPE COEFFICIENT	0.21	35.50	201	0.00
RACE SLOPE COEFFICIENT	0.12	74.02	201	0.00
SES SLOPE COEFFICIENT	0.04	27.69	197	0.00

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B35.--Final model for effects of principal and teacher characteristics on predictors of grade 7 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	240.02	0.74	325.48**
Percent black	-16.25	1.26	-12.86**
Percent Hispanic	-9.00	0.80	-11.27**
Disadvantaged level	-2.33	0.72	-3.22**
Amount of principal time with parents	-0.07	0.73	-0.09
Percent teachers in minority groups	-0.83	1.13	-0.74
Amount of teacher time academic	-0.53	0.83	-0.64
Amount of parent/teacher time	0.40	0.78	0.52
ON GENDER SLOPE COEFFICIENT			
Intercept	-6.19	0.90	-6.86**
Percent black	-0.27	1.45	-0.19
Percent Hispanic	-0.05	1.13	-0.05
Disadvantaged level	0.09	0.92	0.10
Principal years teaching	1.08	0.73	1.49
Amount of principal time with parents	1.28	0.84	1.52
Percent teachers in minority groups	-1.15	1.40	-0.83
Amount of teacher time academic	1.29	1.11	1.16
Amount of parent/teacher time	-2.18	0.79	-2.76**
ON RACE SLOPE COEFFICIENT			
Intercept	-21.91	1.35	-16.18**
Percent black	0.48	2.32	0.21
Percent Hispanic	1.40	1.51	0.93
Disadvantaged level	-0.09	1.53	-0.06
Principal years as principal	2.57	1.59	1.61
Principal years in educational administration	0.22	1.78	0.12
Principal years teaching	-0.96	1.34	-0.71
Amount of principal time academic	-0.41	1.35	-0.30
ON SES SLOPE COEFFICIENT			
Intercept	17.89	0.92	19.49**
Percent black	-4.13	1.07	-3.87**
Percent Hispanic	-3.26	0.96	-3.39**
Disadvantaged level	-1.04	0.82	-1.27
Principal years as principal	-0.30	1.12	-0.27
Principal years in educational administration	0.49	1.09	0.45
Principal years teaching	0.32	0.83	0.38
Amount of principal time academic	0.02	0.84	0.02

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.75	75.87	199	0.00
GENDER SLOPE COEFFICIENT	0.19	29.86	198	0.00
RACE SLOPE COEFFICIENT	0.12	74.25	199	0.00
SES SLOPE COEFFICIENT	0.05	30.14	199	0.00

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B36.--Average within-school predictors of grade 11 science achievement

Predictor	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
INTERCEPT (AVG. ACHIEVEMENT)	283.20	1.33	212.73**
GENDER SLOPE COEFFICIENT	-13.89	1.02	-13.67**
RACE SLOPE COEFFICIENT	-29.49	1.66	-17.75**
SES SLOPE COEFFICIENT	20.92	1.13	18.48**

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.93	406.49	211	0.00
GENDER SLOPE COEFFICIENT	0.19	46.69	211	>0.50
RACE SLOPE COEFFICIENT	0.16	95.90	211	0.18
SES SLOPE COEFFICIENT	0.25	95.62	211	0.18

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B37.--Effects of student body characteristics on predictors of grade 11 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	284.60	0.89	319.27**
Percent black	-13.08	0.97	-13.53**
Percent Hispanic	-7.54	0.88	-8.61**
Disadvantaged level	-3.05	0.90	-3.38**
ON GENDER SLOPE COEFFICIENT			
Intercept	-13.90	1.02	-13.65**
Percent black	0.67	1.08	0.62
Percent Hispanic	0.54	1.17	0.47
Disadvantaged level	0.04	1.20	0.03
ON RACE SLOPE COEFFICIENT			
Intercept	-29.88	1.65	-18.09**
Percent black	-2.47	2.10	-1.17
Percent Hispanic	2.86	1.74	1.65
Disadvantaged level	2.34	1.72	1.36
ON SES SLOPE COEFFICIENT			
Intercept	21.36	1.09	19.62**
Percent black	-2.80	1.38	-2.04*
Percent Hispanic	-3.61	1.14	-3.16**
Disadvantaged level	-1.07	1.08	-0.98

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.81	140.69	208	0.00
GENDER SLOPE COEFFICIENT	0.19	46.38	208	>0.50
RACE SLOPE COEFFICIENT	0.14	84.50	208	0.24
SES SLOPE COEFFICIENT	0.21	72.02	208	0.31

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B38.--Final model for effects of fiscal and physical school characteristics on predictors of grade 11 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	285.23	0.97	292.96**
Percent black	-13.66	0.95	-14.42**
Percent Hispanic	-7.61	0.85	-8.94**
Disadvantaged level	-2.48	0.90	-2.76**
Instructional funds/student	0.96	0.92	1.04
Microcomputers/student	-0.69	1.06	-0.65
Have general science lab	-3.00	0.99	-3.02**
General science lab unknown	-2.89	3.91	-0.74
Have specialized science lab	5.12	1.07	4.79**
Specialized science lab unknown	-4.19	4.63	-0.90
ON GENDER SLOPE COEFFICIENT			
Intercept	-13.93	1.19	-11.71**
Percent black	0.69	1.09	0.63
Percent Hispanic	0.66	1.17	0.56
Disadvantaged level	0.32	1.20	0.26
Instructional funds/student	-0.71	1.04	-0.68
Microcomputers/student	-1.02	1.39	-0.74
Have specialized science lab	-0.58	1.35	-0.43
Specialized science lab unknown	-0.94	4.45	-0.21
ON RACE SLOPE COEFFICIENT			
Intercept	-30.10	1.97	-15.29**
Percent black	-2.86	2.10	-1.36
Percent Hispanic	2.78	1.73	1.61
Disadvantaged level	2.29	1.77	1.29
Instructional funds/student	1.48	1.88	0.79
Microcomputers/student	-2.19	2.13	-1.03
Have specialized science lab	-0.76	2.15	-0.35
Specialized science lab unknown	-1.69	5.54	-0.30
ON SES SLOPE COEFFICIENT			
Intercept	20.67	1.37	15.07**
Percent black	-2.68	1.36	-1.97*
Percent Hispanic	-3.74	1.15	-3.25**
Disadvantaged level	-1.17	1.11	-1.06
Instructional funds/student	-0.81	1.51	-0.53
Microcomputers/student	0.72	1.64	0.44
Have specialized science lab	2.32	1.67	1.39
Specialized science lab unknown	2.93	3.88	0.75

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.79	122.87	202	0.00
GENDER SLOPE COEFFICIENT	0.18	46.29	204	>0.50
RACE SLOPE COEFFICIENT	0.15	86.38	204	0.26
SES SLOPE COEFFICIENT	0.20	71.09	204	0.20

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B39.--Final model for effects of school structure characteristics on predictors of grade 11 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	284.48	0.92	308.79**
Percent black	-13.43	0.93	-14.38**
Percent Hispanic	-7.97	0.86	-9.28**
Disadvantaged level	-3.36	0.88	-3.81**
Science tracking	2.12	0.89	2.38*
Science tracking unknown	-6.30	2.80	-2.25*
Student/teacher ratio	0.76	1.08	0.70
School size (number of students)	3.82	0.90	4.23**
ON GENDER SLOPE COEFFICIENT			
Intercept	-13.70	1.16	-11.82**
Percent black	0.76	1.09	0.69
Percent Hispanic	0.61	1.25	0.49
Disadvantaged level	0.21	1.22	0.17
Science tracking	-0.99	1.07	-0.93
Science tracking unknown	-0.86	4.27	-0.20
Student/teacher ratio	0.01	1.88	0.00
School size (number of students)	-0.41	1.16	-0.36
ON RACE SLOPE COEFFICIENT			
Intercept	-30.60	2.02	-15.12**
Percent black	-2.42	2.12	-1.14
Percent Hispanic	2.63	1.88	1.39
Disadvantaged level	1.83	1.74	1.05
Student/teacher ratio	1.23	2.24	0.55
School size (number of students)	1.82	1.72	1.06
Classroom organization:			
Self-contained classrooms	-1.20	2.41	-0.50
Classroom organization unknown	-0.58	5.04	-0.12
ON SES SLOPE COEFFICIENT			
Intercept	21.43	1.31	16.37**
Percent black	-2.85	1.40	-2.04*
Percent Hispanic	-3.94	1.17	-3.36**
Disadvantaged level	-1.10	1.18	-0.93
Student/teacher ratio	1.47	1.75	0.84
School size (number of students)	-0.01	1.43	-0.01
Classroom organization:			
Self-contained classrooms	0.91	1.88	0.48
Classroom organization unknown	1.68	3.64	0.46

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.79	122.44	204	0.00
GENDER SLOPE COEFFICIENT	0.19	46.55	204	>0.50
RACE SLOPE COEFFICIENT	0.15	86.69	204	0.26
SES SLOPE COEFFICIENT	0.21	73.20	204	0.29

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability ≤ .01; * probability ≤ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B40.--Final model for effects of academic standards on predictors of grade 11 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	284.95	0.91	311.63**
Percent black	-12.84	0.97	-13.24**
Percent Hispanic	-7.70	0.88	-8.74**
Disadvantaged level	-2.54	0.89	-2.86**
Rigor in academic standards	1.43	0.94	1.52
Rigor unknown	-5.34	7.10	-0.75
Change in academic standards	-0.22	0.99	-0.22
Change unknown	-1.35	6.65	-0.20
Amount of homework	4.41	1.00	4.41**
Teacher control in school	1.06	1.00	1.06
ON GENDER SLOPE COEFFICIENT			
Intercept	-13.91	1.05	-13.30**
Percent black	0.71	1.11	0.64
Percent Hispanic	0.50	1.17	0.43
Disadvantaged level	0.09	1.23	0.07
Amount of homework	0.25	1.34	0.19
Teacher control in school	0.22	1.20	0.18
ON RACE SLOPE COEFFICIENT			
Intercept	-29.84	1.70	-17.50**
Percent black	-2.65	2.26	-1.17
Percent Hispanic	2.85	1.74	1.63
Disadvantaged level	2.24	1.69	1.33
Amount of homework	-2.11	1.88	-1.12
Teacher control in school	-0.84	2.07	-0.41
ON SES SLOPE COEFFICIENT			
Intercept	21.03	1.27	16.50**
Percent black	-2.80	1.42	-1.98*
Percent Hispanic	-3.48	1.16	-3.00**
Disadvantaged level	-1.17	1.16	-1.01
Rigor of academic standards	0.41	1.66	0.25
Rigor unknown	-2.00	9.97	-0.20
Change in academic standards	-0.53	1.34	-0.39
Change unknown	3.75	9.55	0.39
Amount of homework	1.30	1.49	0.87
Teacher control in school	0.18	1.37	0.13

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.79	124.18	202	0.00
GENDER SLOPE COEFFICIENT	0.19	46.73	206	>0.50
RACE SLOPE COEFFICIENT	0.14	84.61	206	0.21
SES SLOPE COEFFICIENT	0.20	71.67	202	0.27

[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

Table B41.--Final model for effects of principal and teacher characteristics on predictors of grade 11 science achievement

Effect	Gamma Coefficient[1]	Standard Error[2]	t Value[3]
ON INTERCEPT (AVG. ACHIEVEMENT)			
Intercept	284.45	0.90	316.71**
Percent black	-12.03	1.33	-9.04**
Percent Hispanic	-7.10	1.00	-7.07**
Disadvantaged level	-3.35	0.94	-3.58**
Percent teachers in minority groups	-1.29	1.35	-0.95
Amount of teacher time academic	-0.48	1.09	-0.44
Amount of parent/teacher time	-0.76	1.01	-0.75
ON GENDER SLOPE COEFFICIENT			
Intercept	-14.07	1.04	-13.47**
Percent black	1.03	1.53	0.68
Percent Hispanic	0.61	1.31	0.47
Disadvantaged level	-0.04	1.23	-0.03
Principal years teaching	0.00	1.29	0.00
Amount of principal time with parents	0.39	0.98	0.40
Percent teachers in minority groups	-0.52	1.56	-0.33
Amount of teacher time academic	-0.45	1.34	-0.33
Amount of parent/teacher time	0.03	1.14	0.02
ON RACE SLOPE COEFFICIENT			
Intercept	-30.27	1.71	-17.71**
Percent black	-0.33	2.69	-0.12
Percent Hispanic	3.64	2.04	1.79
Disadvantaged level	1.33	1.82	0.73
Principal years teaching	0.77	1.75	0.44
Principal years in educational administration	-1.26	1.52	-0.83
Amount of principal time with parents	-2.21	2.81	-0.79
Percent teachers in minority groups	-0.01	2.16	0.00
Amount of teacher time academic	-2.30	1.99	-1.16
Amount of parent/teacher time	2.10	1.53	1.37
ON SES SLOPE COEFFICIENT			
Intercept	21.40	1.11	19.36**
Percent black	-2.29	1.76	-1.31
Percent Hispanic	-3.52	1.27	-2.76**
Disadvantaged level	-1.08	1.09	-0.98
Amount of principal time with parents	-0.48	1.25	-0.39
Amount of principal time academic	-0.33	1.69	-0.20
Amount of teacher time academic	2.17	1.39	1.56
Amount of parent/teacher time	-0.92	1.45	-0.64

	Reliability[4]	Parameter Variance (Tau)[5]	Degrees of Freedom	Probability of Tau > 0[6]
INTERCEPT (AVG. ACHIEVEMENT)	0.81	141.75	205	0.00
GENDER SLOPE COEFFICIENT	0.19	47.22	203	>.50
RACE SLOPE COEFFICIENT	0.15	85.97	202	0.24
SES SLOPE COEFFICIENT	0.21	72.98	204	0.30

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[1] Average of five gamma values. See technical notes for more information.

[2] Average of five standard error values plus standard error of the five gammas. See technical notes for more information.

[3] Gamma divided by standard error. Probabilities based on a two-tailed test.

[4] Parameter variance divided by total variance. Average of five reliability tests.

[5] Average of five parameter variance values.

[6] Average of five probability values. Probabilities obtained from Chi-Square tests.

NOTE: ** probability $\leq$ .01; * probability $\leq$ .05.

SOURCE: U. S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, 1985-86 Public-Use Date Tapes.

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